How can I use the classroom computers to improve the math skills of at-risk students?

Samantha Nicholson

Biography

Samantha is currently a Grade five teacher at Delhi Public School. She has been a teacher for the past eleven years. She has taught as a classroom teacher in the primary, junior and intermediate divisions in addition to ESL, Resource, and Music. For the past three years she has taught Grade five in both straight grade and split classes.

Abstract

I did not believe that the computers in my classroom were being used as effectively as possible. Although I had my class use the computer lab, for a variety of activities, as frequently as availability would allow, I wanted to make better use of my two classroom computers. As well, this particular class had a number of students who were at-risk in mathematics and/or language. Two students were selected as focus students who participated in an almost exclusively computer-based math program. The progress of the students, and the struggles and successes with the program's implementation, are documented in this paper.

Background

Delhi Public School is a rural kindergarten to Grade six school, in Ontario, with approximately 400 students who have diverse backgrounds. There is a computer lab with twenty-nine computers available for student use in addition to the one or two computers that are located in each classroom.

My Grade five class this year currently has thirty students with 15 girls and 15 boys. The majority of students in the class do not have access to a computer at home.

Rationale

When the flyer requesting teachers interested in computers in the classroom came out I was interested. I wanted to find a way to utilize the two computers in my classroom more effectively. I was fairly comfortable with the way the class time in the computer lab was being utilized, related to curriculum, and engaged the students in active learning. The class has a website which allows each student to publish his/her work on the Internet. This allowed for a lot of word processing experience for the students, including saving to disk. I was also interested in expanding the ways in which I used the lab to include more Science and Social Studies. While I was deliberating over exactly what I wanted to focus on in my research, I began to more effectively utilize StudentLink2 for Science and Social Studies as this was an area that I was contemplating as a focus. As a result, the issue still remained regarding more effective use of the classroom computers.

At-risk students were a group that I really wanted to try to reach so that they could experience more success as much of the Grade five program was far beyond their capabilities. These are not the identified students in my class for whom I am able to modify the programming content.

My next realization was that the logical step would be to connect my computer research and further assist those at-risk students.

Hypothesis

I have found that students generally respond more readily to the computer than they do to paper and pencil and other "regular" tasks. My focus question became: How can I use the classroom computers to improve the math skills of at-risk students?
The questions that I still had:

1. What computer programs could I use effectively?
2. How would I track their progress?
3. How would the rest of the class respond to the students that are using the computers when they are doing the "regular program"?
4. How would the parents of the students working at the computers respond to their child's work being done this way?
5. How will I structure things when I have numerous at-risk students in math?

Procedure

I began by selecting two at-risk students to focus on who were not identified students. I felt that it was essential to select non-identified students because identified students seem to have more avenues for help through modification of programs and expectations than non-identified students who are at-risk.

The two students both happen to be girls who are at-risk in both mathematics and language. Breanna has significant attention issues and is extremely weak in math, is easily frustrated and has few problem solving skills. Brittany is a selective mute with very little self-confidence and often refuses to attempt work. Brittany is difficult to work with even in a 1:1 setting as she will not communicate most of the time. For terms two and three, the two girls participated in the lessons as part of the class and then had related work to do at the computers in the classroom. I explained to the class that I was doing some research regarding computers in the classroom and that I had selected two students to be my "guinea pigs". The girls were quite excited to be selected and the rest of the class seemed to be fine with the idea. There was some grumbling the first couple of days when it came time to "work" and Brittany and Breanna went to the computers, but quite quickly it became part of the normal routine. An information letter was sent home outlining the project with a request to return the signed consent form.(See Appendices A and B) Informed consent was received.

It took a while for me to find an appropriate program and get it installed on the classroom computers. The program that I had the girls primarily using was MathTrek 4, 5, 6. It made selecting the appropriate daily assignment selection for them much easier for me. Until this was installed, I had to do a daily search of StudentLink2 and the web to find appropriate activities for them. MathTrek 4, 5, 6 still required me to select the appropriate activities but it was a fairly quick process. MathTrek has tutorials that are quite good but neither one of the girls was strong enough in language to effectively use them. On occasion we did use the tutorials as a class as an interactive lesson.

The activities section is useful in MathTrek 4, 5, 6 but often required the students to have practised a variety of the skills of that particular strand of math before attempting them. (By June, the girls were able to independently use this part of the program and had fun. The added bonus was that it helped develop their problem-solving skills.) The more that Brittany and Breanna used this program, the more I liked it. It was only natural that I then had the entire class using it when we were in the lab. In the classroom, the practise and testing areas were used on almost a daily basis with Breanna and Brittany.

Results

After Brittany and Breanna had been working on the computers for about a month, I contacted the parents and then sent home a survey to be completed by the parents. Brittany and Breanna were given a survey of their own to complete.

I like math	1	2	***3***	***4***	***5***
I like using the computer to do math	1	2	3	4	***5***
Using the computer helps me in math	1	2	3	4	***5***
I like doing math with paper and pencil	***1***	2	3	4	5
I can do paper and pencil math by myself	1	2	3	***4***	5
I can do computer math by myself	1	2	***3***	4	5
I am good at paper and pencil math	1	***2***	3	4	5
I am good at computer math	1	2	3	4	***5***

Breanna's Survey Results

The results of this survey are quite interesting. The fact that Breanna believes that she is able to complete paper and pencil math by herself but does not believe that she is very good at it indicates a lack of awareness of her own strengths and weakness. Breanna usually has most, if not all, paper and pencil math incorrect if she is not assisted, one-to-one. At this point, she is obviously more self-confident working on the computer. She is also far more willing to work on the computer. Due to her attention difficulties, it was often difficult to get Breanna to do seat-work. She is eager to work at the computer and usually is able to focus on the task at hand. This behaviour is typical of most students: they would rather work on an activity that they enjoy. For Breanna, it is the difference between working and experiencing some success, and doing very little work with no success.

1. Please rate what you believe to be your child's grade appropriate math skills for standard paper and pencil activities.

1 2 ***3*** 4 5

2. Please rate what you believe to be your child's self-confidence with his/her math skills for standard paper and pencil activities.

1 2 3 4 5

3. Do you feel that using the computers in the classroom for math has been beneficial for your child or will be beneficial in the long run?

Yes No

Comments: Breanna has expressed to me how much she enjoys completing math assignments on the computer. She actually is enthusiastic about math work now. I encourage her to keep up the good work.

4. Please rate your child's self-confidence for math when using computers. (Feel free to discuss this with them.)
1 2 3 4 ***5***

Breanna's Mother's Survey Results

From this initial survey, Breanna's mother appears to be quite pleased with her daughter's progress and improved attitude towards math.

I like math	1	2	3	***4***	5
I like using the computer to do math	1	2	3	4	***5***
Using the computer helps me in math	1	2	3	4	***5***
I like doing math with paper and pencil	***1***	2	3	4	5
I can do paper and pencil math by myself	***1***	2	3	4	5
I can do computer math by myself	1	2	3	***4***	5
I am good at paper and pencil math	***1***	2	3	4	5
I am good at computer math	1	2	3	4	***5***

Brittany's Survey Results

Brittany's responses are quite clear. She does not feel successful at, nor does she like, paper and pencil math.

The survey that Brittany's mother completed supports these ideas:

1. Please rate what you believe to be your child's grade appropriate math skills for standard paper and pencil activities.
1 ***2*** 3 4 5
2. Please rate what you believe to be your child's self-confidence with his/her math skills for standard paper and pencil activities.
1 ***2*** 3 4 5
3. Do you feel that using the computers in the classroom for math has been beneficial for your child or will be beneficial in the long run?
Yes No
Comments: She enjoys it more and says it's easier for her.

4. Please rate your child's self-confidence for math when using computers. (Feel free to discuss this with them.)
1 2 3 4 ***5***
Comments: She says she feels better using the computer.

Brittany's Mother's Survey Results

Despite numerous technical problems, once MathTrek 4, 5, 6 was installed and running properly it was a great program for most areas of mathematics. There were a few areas that did not work at a low enough level. In particular, the multiplication and division areas were significantly too challenging for these two students. The program did allow them to recognize the connection between multiplication and division, but skill-wise, it was far too challenging. In geometry, the program does allow you to use a protractor to measure angles; however, it proved to be tricky to manipulate the protractor and read it. The entire class tried this section of the program and a significant number of the class found it to be much harder than actually using a protractor. Some of these problems could easily have been solved by using a different program, such as Math Team or even MathTrek 1, 2, 3. The problem is that MathTeam is not currently installed on the computers and MathTrek 1, 2, 3 is not currently available at the school.

One problem that did recur throughout the project was that Breanna would not participate in, or focus on, the lessons. When I spoke to her about this she said that this was because she was not going to be doing the same work as the rest of the class so she did not need to listen. Although I discussed with her, repeatedly, the fact that she was doing the same type of work, just on the computer, she continued to "miss" the lessons.

Occasionally, I tried to have Brittany and Breanna complete the same work as the class. Every time that this occurred, neither student was successful nor were they happy about having to do "regular math". Each time, they both became frustrated. Brittany frequently completed very little work and what was completed was mostly incorrect. Breanna was very challenging to keep on task, frequently disturbed others and met with very little success. An example of this occurred during our unit on transformational geometry. Both students had mainly worked on the computer for this unit but had completed a few "regular" activities with the class using manipulatives and paper and pencil. At the end of this particular unit, I had both students do a written activity along with the rest of the class involving similar questions to those they had been working on at the computer. Both Brittany and Breanna scored 30%. The next day, they both did another evaluation, this time at the computer. Even though the questions were very similar to the previous day's questions, both students scored remarkably higher. Brittany went up to 50% and Breanna went up to 63%. I believe that the second day is a far better reflection of their true capabilities. Obviously the students had far more knowledge than they were able to demonstrate in "traditional" ways.

When we began our unit on volume, capacity and mass, Brittany and Breanna did the initial activities on paper (using manipulatives) with the rest of the class. They were unable to complete these activities. When they then moved to the computer the next day, and for the rest of the unit, they were more successful. At the end of the unit, both students were able to demonstrate some understanding of the basic concepts of volume, capacity and mass and feel successful. Again, using the computers allowed me to keep the work at grade level, doing similar activities as the rest of the class yet basic enough that the students were able to clearly demonstrate what they know, be happy working, and stay focused on the task at hand. This reduced the amount of disruption that Breanna caused and Brittany completed work on her own. Both of these are significant issues for these two students.

Some aspects of this project have been extremely valuable by allowing me to more accurately access the students' abilities. One such time occurred when I sat with the two students while they worked at the computer. They were working on some patterning activities that involved continuing the patterns, which became progressively more difficult. As I sat with them, I tracked the number of attempts required before they solved the pattern, the number correct, and the level of difficulty. Throughout this process, I tried not to interfere and just observe their work. I did occasionally ask a question or two to find out what strategies, if any, they were using to solve the patterns. At first, Brittany was quite slow, mostly because she lacked confidence. Once she had a few correct answers she moved along quite well. When she went up to the next level of difficulty, again, she seemed to withdraw and almost give up. Once

she finally solved a couple of problems, then she was able work more efficiently. Rarely in this process was she able to quickly continue the pattern, but she did approach them methodically and demonstrated perseverance and some strong problem solving skills. This really surprised me because I had not been aware of Brittany's abilities in this area from regular class work and because communication with her can be difficult. Breanna struggled right from the easiest level. It was very apparent that she often randomly guessed and had few problem solving skills. She was often unable to see even simple patterns and was clearly unable to work backwards to solve the pattern even when I intervened. Using the computer in this situation allowed me to see far more of the abilities and strategies used by the students than if I simply worked with them in a one-to-one setting as both girls tend to give up or simply not work on paper and pencil or manipulative-based seat-work.

Throughout this process there have been some significant benefits for both the students and myself. The students are far happier working at the computer. They are able to complete a great deal more work and feel successful with mathematics. One of the benefits for me has been a better use of my time. These are the students who are not able to complete regular class work and often need a different assignment. Using the computer greatly lessens the amount of time I have to spend searching for appropriate work. It does not take long to check the program to see which activities are best suited to the lesson/strand/activity for that day. At the start of the fourth month of the project, I was still frustrated by not having the programs available to me that are supposed to be on the computer, especially Math Team as it allows for practising of skills at a lower level.

I have begun to expand the idea of alternative testing (at the computer) to my entire class with a significant amount of success. One such time occurred when the class was reviewing decimals. At the end several days of review, the class completed a paper and pencil activity that involved both basic skills and problem solving. Later that same day, in the computer lab, the class completed another evaluation of their knowledge of decimals using a test on MathTrek 4, 5, 6. As a whole, the class scored significantly higher using the computer. This can partially be attributed to the fact that there was very little problem solving involved in this particular computer test. Despite this, however, the students were able to clearly demonstrate their knowledge of decimals.

They were also happier completing this activity and more activity engaged in their learning. Breanna and Brittany completed this same test twice. Once in the morning while the class did their "regular" work and again with the rest of the class in the afternoon. The second time that they completed it, they scored remarkably high. For the first time, both of them scored higher than some other students in the class. Brittany scored 73% and Breanna scored 87%. This is the best that these two students have done this year. This demonstrated a huge improvement in their understanding of basic number concepts.

Throughout this process, if what the two students were working on was too challenging for them, I would have one of my top students who had already finished his/her work sit with each of them and guide them through the activity. This worked out quite well. Again, more options in choice of computer programs might have made this step unnecessary.

After about 4.5 months of working at the computer for math, I gave the two students and their parents another survey to complete. The results of those are:

I like math	1	2	3	***4***	5
I like using the computer to do math	1	2	3	4	***5***
Using the computer helps me in math	1	2	3	4	***5***
I like doing math with paper and pencil	1	2	***3***	4	5
I can do paper and pencil math by myself	1	***2***	3	4	5
I can do computer math by myself	1	2	3	4	***5***

I am good at paper and pencil math	***1***	2	3	4	5
I am good at computer math	1	2	3	4	***5***
I want to do my math on computer next year	1	2	3	4	***5***
I want to try doing all of my language on the computer	1	2	3	4	***5***

Breanna's Second Survey Results

Breanna's second survey, when compared with the first survey, clearly indicates that she is more confident with math, enjoys it more and feels successful when completing computer-based math. She obviously would like to continue to work at the computer and would like to extend this into other areas of the curriculum.

1. Do you believe that using the computer in math class has improved your child's ability to understand the work?
Yes No Undecided
Comments: I feel it is less confusing to focus on one single question at a time. It helps her to concentrate.

2. Do you believe that using the computer in math class has improved your child's ability it do the work?
Yes No Undecided
Comments: She feels much more confident.

3. Do you believe that using the computer in math has increased your child's self-confidence in math?
Yes No Undecided
Comments: Definitely

4. Do you feel that using the computers in math has improved your child's ability to do "traditional" paper and pencil math?
Yes ***No*** Undecided
Comments: I feel that she is one of those selected few children that does not do well with paper/pencil work.

5. Do you believe that using the computers in math class for the last five months has been beneficial for your child?

Yes No Undecided
Comments: Increases motivation to do math work & higher self-esteem knowing that she can do math.

6. Would you like to see the almost exclusive use of computers extended to the language program (as much as possible)?
Yes No Undecided
Comments: Use in any area would be beneficial to most children.

7. What benefits, if any, would you see from using the computers in language?
As indicated above, many benefits for children who do not do well with paper/pencil.

Breanna's Mother's Second Survey Results

From the results of the survey, it is apparent that Breanna's mother is pleased with the results of Breanna's time at the computer. Although her mother does not believe that Breanna's ability to do paper and pencil math has improved, it significantly has improved. It may not be up to grade level but she has definitely improved. Whether or not this improvement would have occurred without the use of computers is unknown. What is directly related to the use of computers is Breanna's willingness to attempt the work, her ability to focus on the task at hand and thereby cause fewer disturbances in the classroom.

I like math	**1**	2	3	4	5
I like using the computer to do math	1	2	3	4	**5**
Using the computer helps me in math	1	2	3	4	**5**
I like doing math with paper and pencil	**1**	2	3	4	5
I can do paper and pencil math by myself	1	2	**3**	4	5
I can do computer math by myself	1	2	3	4	**5**
I am good at paper and pencil math	1	**2**	3	4	5
I am good at computer math	1	2	3	**4**	5
I want to do my math on computer next year	1	2	3	4	**5**
I want to try doing all of my language on the computer	1	2	3	4	**5**

Brittany's Second Survey Results

Brittany's second survey indicates that although math is not a subject she enjoys, she does like doing the activities at the computer. According to the survey results, she is more comfortable completing "regular" paper and pencil math activities than she was before she started using the computer. She obviously would like to continue to work at the computer and would like to extend this into other areas of the curriculum.

Brittany's mother misinterpreted the instructions for this survey and completed it with Brittany, using her as a guide, rather than basing it on her own interpretation of what had taken place.

1. Do you believe that using the computer in math class has improved your child's ability to understand the work?
Yes No Undecided
Comments: She says, "Yes - kinda".

2. Do you believe that using the computer in math class has improved your child's ability it do the work?
Yes No Undecided
Comments: She says she can.

3. Do you believe that using the computer in math has increased your child's self-confidence in math?
Yes No Undecided
Comments: She feels better about it.

4. Do you feel that using the computers in math has improved your child's ability to do "traditional" paper and pencil math?

Yes ***No*** Undecided

Comments: She still needs all my help at home. She struggles here at home.

5. Do you believe that using the computers in math class for the last five months has been beneficial for your child?

Yes No Undecided

Comments: She likes it better than doing it on paper.

6. Would you like to see the almost exclusive use of computers extended to the language program (as much as possible)?

Yes No Undecided

Comments: Most definitely.

7. What benefits, if any, would you see from using the computers in language?

She prefers working on the computer, instead of writing on paper.

Additional Comments: As far as math homework at home, I am still sitting with her for pretty much every question.

Brittany's Mother's Survey Results

This survey shows how valuable using the computer is for Brittany. When working at the computer, she does not need someone sitting beside her guiding her through every step. As soon as she is working away from the computer, she is extremely reluctant to attempt anything on her own.

Another benefit of working at the computer was that neither student had math homework. Since both of these students were at-risk in language and math, they required a significant amount of parental support for completing any tasks that were not finished in class. By virtually eliminating the math homework, this reduced the stress at home, over homework, for both the parents and children.

Analysis

I have always believed that computers were beneficial. I have devotedly used the computer lab with my class for a variety of activities as frequently as availability would allow. I did not, however, see how I could make the best use out of the classroom computers nor how to best utilize them to help my at-risk students. In addition, I had some concerns regarding the almost exclusive use of the computers and the challenges that go with that situation. Given the temperaments of the students in the class, I was very surprised that the rest of the class did not put up a fuss regarding Brittany and Breanna's use of the computer after the first day or two. I had really thought that this would be a problem for the others in the class but they adjusted quite quickly to this routine. However, the situation had been described to them as part of a research project so I'm not sure how they would have reacted had it not been "a project".

After completing this project, I believe that the benefits for both the students and myself of using the computers to this extent are huge. Tracking progress was not as challenging as I thought it would be, due in part to MathTrek 4, 5, 6. Programming so that these students met with success was far simpler for me than prior to the start of this

project and therefore freed my time to help other students and plan for their individual needs. More importantly the students met with a great deal of success every day. That did not happen before. For Breanna, improved behaviour was an additional bonus and for Brittany it was her increased willingness to take risks and complete work.

Part way through the project I had another realization: I would love to have a class able to work 50-80% of the day in the computer lab. I found only having two computers in my classroom limiting (although I am very grateful that I have two and that they both work). I used to think that every student having a computer was unnecessary, that they would not really "learn", and that basic skills would be missed. Now I believe that the opposite is true. Computers are an essential tool in the classroom. They are as important as paper, pencils and textbooks. Aside from the obvious issues that would arise from technical malfunctions, the benefits of a computer-based classroom far outweigh the disadvantages. I now have a vision of the ideal classroom where there is a computer on every desk. Until that vision is realized, I plan to employ the use of the computers in both the classroom and lab as much as possible. Due to this research project, my view of the possible uses for the computer are significantly more far-reaching than they ever were before.

Conclusions

Computers are a great tool to improve the math skills of at-risk students. Next year, I would like to extended this programming option to more of my at-risk students. With only two classroom computers, when this program is extended to more students it will not be able to be an exclusively computer based program. I believe that this will limit the success of it to a certain extent while at the same time providing opportunity for more students. As well, I would like to extend this even further into my language program. (I have begun already to utilize the classroom computers for my reluctant writers as much as possible.) A great deal of the success of this programming option is dependent on the computer programs that are available and the support of the IT department. Overall, the use of computers was able to significantly improve the math skills of those two at-risk students in my class.

Appendix 1

Parental Letter

Title of the project: How can I use the classroom computers to improve the math skills of at-risk students?

Dear Parent or Guardian:

This letter is to request your permission for your son/daughter to participate in an action research project. I am conducting a research project to determine how classroom computers can be used to help students who are weak in math.

Your child will be asked to complete two surveys, one at the start and one near the end of the project, to discuss how they feel about their experiences using the computers for their math program. You, as the parent, will also be asked to complete two surveys regarding your feelings about the success of the program.

Your child will be participating in regular math lessons but will complete most math activities at the computer. Your child may choose not to use the computers if he/she wishes. Participation in this project is strictly voluntary.

The information I learn and the data that I collect will be reported in a research paper. Only first names of the participants will be used. Findings may be shared with other teachers in a workshop or in a book.

Please complete the attached permission form to indicate your consent for your child to participate in this study.

Sincerely,

Samantha Nicholson
Grade 5 Teacher
Delhi Public School

Appendix 2

Consent Form

Consent for Participation in Research Project

I, _____, give consent for my child, _____, to
(Print name)
participate in the research project (from January 2004 to June 2004) regarding the use of computers for mathematics. I realize and accept that my child's first name will be used as part of the written project which may be published.

Signed_____

Dated_____