UTILIZING ASSISTIVE TECHNOLOGY IN INCLUSIVE CLASSROOMS: LEAVING NO CHILD WITHOUT

By

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ABSTRACT

Students those who are at-risk and with disabilities often benefit from strategically designed computer supported assignments and instruction. This paper summarizes a research study which included a focus on training participants to effectively utilize hand-held computers and select software programs in planning, delivering, and assessing daily instruction in inclusive elementary school settings. This information is beneficial to academicians, practitioners and the training design can be generalized across fields.

Keywords: Early childhood literacy, reading, instructional technology, learning assessments.

INTRODUCTION

One of the major challenges confronting educators working in inclusive classrooms is ensuring that no child is left without the support needed to fully realize her/his learning potential. However, the extent to which children gain support depends largely on teachers' knowledge of the kinds of support available for use in inclusive classrooms. For general educators, their teacher preparation programs often do not expose them to assistive technology, an area that has gained prominence in discussions of inclusion. The Math, Assistive Technology, and Reading (MATR) Project set out to address this problem using professional development as the delivery system with the content of training focused on using assistive technology to enhance reading and math instruction in inclusive classrooms. This paper describes four critical aspects of the MATR project. First is a summary of the rationale for engaging in the project. Second, the key design features of the MATR model are described. Third, the results of the project are presented, followed by a discussion of implications for further work. The overall intent of this paper is to present information about how to provide the support that educators need to leave fewer children without the support that assistive technology offers for addressing the diverse literacy and numeracy needs of students in inclusive classrooms.

Rationale for Developing the MATR Project

The rationale for developing this project is three-fold: a) limited access to assistive technology training; b) low student performance in the areas of reading and math; and c) evidence of the potential value of using assistive technology devices to improve learning. As alluded to above, teacher education programs for general education practitioners seldom include information about assistive technology, though some have begun to require teachers to take a course in special education. In the midst of rapidly evolving electronic technologies, it is reasonable to assume that assistive technology would be treated in professional development programs for in-service teachers. When exploring the availability of access to training in assistive technology in the local area, it was discovered that no training was being offered on the topic of assistive technology, though some technology training was being offered for in-service teachers.

Student scores in reading and math show a persistent pattern of low performance across school districts. In the authors' particular area, this same pattern was evident. Demographic data showed the diversity of the student population in urban schools in the mid-south, and the standardized test scores demonstrated low success rates in reading and math for ethnically diverse students. The implication was that teachers need support in the delivery

of instruction in math and reading. And indeed, this led to the question of how much empirical support is there for the use of assistive technology to enhance learning.

A growing body of research has begun to demonstrate the efficacy of using assistive technology to enhance the reading and math performance of students of different learning abilities. Rose and Meyer (2002) made a distinction between access to information and access to learning, two main foci of assistive technology as it pertains to print. Access to information focuses largely on giving one access to the medium of print through alternate formats and alternate media and is used largely with individuals with high-incidence disabilities. Access to learning focuses largely on support for learning to read, especially in inclusive classrooms where students are more likely to have qualities associated with low-incidence disabilities. The access to learning research was of special interest to this work.

Evidence that assistive technology had great potential for improving students' access to learning was extremely convincing. In the research of Higgins and Raskind (2005), the Quicktionary Pen and its effects on the reading of students with disabilities were examined. The Quicktionary Pen is a form of an optical character recognition system that scans words and reads them aloud for the student. They found that at the end of a two week period, students using the Quicktionary Pen improved in their word recognition skills. Another example is found in the work of Beck, Jia, and Moslow (2004) where the focus is on using a computer tutor to assess the students' reading proficiency. They used data that a computer tutor collected through interactions with a student to estimate his performance on a human-administered test of oral reading fluency. Results showed that data from the speech recognizer were more useful than student help-seeking behavior, but the combination of both yielded in better results.

A third area to be highlighted deals with the development of reading strategies, as found in the work of Magliano, Todaro Millis, Wiemer-Hastings, Kim, and McNamara (2005). A live program developed by McNamara called 'Self-Explanation Reading Training' (SERT) was compared to an automated version of SERT to teach readers to use active reading strategies. The findings showed that individuals with higher skills prior to the intervention had much more success than individuals who had lower reading skills initially. Yet, less skilled readers still increased their production of relevant self-explanations and their strategy use scores. Together these studies show the potential for using assistive technology to enhance the learning of students in inclusive classrooms.

With the above three areas in mind, the authors set out to develop a professional development project that would support teachers' knowledge and ability to use assistive technology as a means of not leaving children in inclusive classrooms without the support they need to learn the basics of math and reading, the two areas widely acknowledged as foundational skills for all other learning.

The MATR Project

The instructional model of the MATR Project guided the implementation procedures. Module I focused on introducing major concepts in the areas of reading, math, and assistive technology. Module II focused on strategies for utilizing assistive technology in integrated reading and writing lessons. Module III focused on diversity and inclusion. Module IV focused on utilizing standards-based teaching methods to guide the planning of instruction. Participants were taught to utilize various assistive technology devices. The devices ranged from low tech to high tech assistive technology supports. The use of assistive technology devices were demonstrated in the training. To gain comfort with using the assistive technology devices, participants worked in groups to familiarize themselves with the various devices and to develop lesson plans in which the devices were used to differentiate instruction. Participants also received a tool kit consisting of assistive technology tools used in the training, including hand-held computers, digital voice recorders, book readers, and Quicktionary Pens. As a final test of their knowledge and skills, teams worked together to plan and present workshops to colleagues that demonstrated the use of assistive technologies to differentiate instruction in reading and math.

A critical aspect of the model is the use of standards-based instruction, the focus of Module III. Figure 1 shows how module III builds from Modules I and II.

Results of the MATR Project

The main question to be addressed was how well the teacher support system worked. Data were collected from participants of ten schools: eight public schools, one charter school, and one private school. Working in school teams, consisting of a general educator teacher, a special education teacher, a para-educator, and a curriculum leader, the participants were expected to expand their knowledge of assistive technology, reading, and math, their ability to utilize assistive technology to differentiate instruction in reading and math, and their ability to train others to use assistive technology in inclusive classrooms.

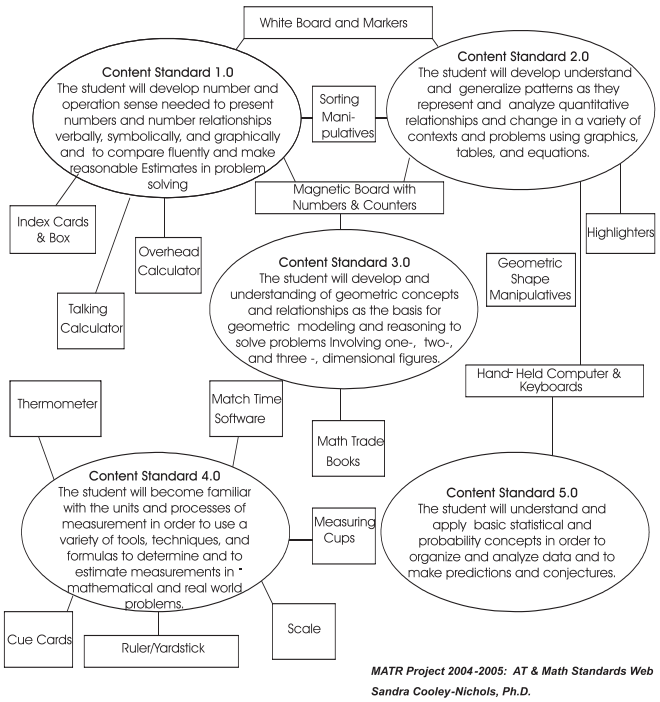

Figure 1. Assistive Technology and Tennessee K-3 Math Standards Web

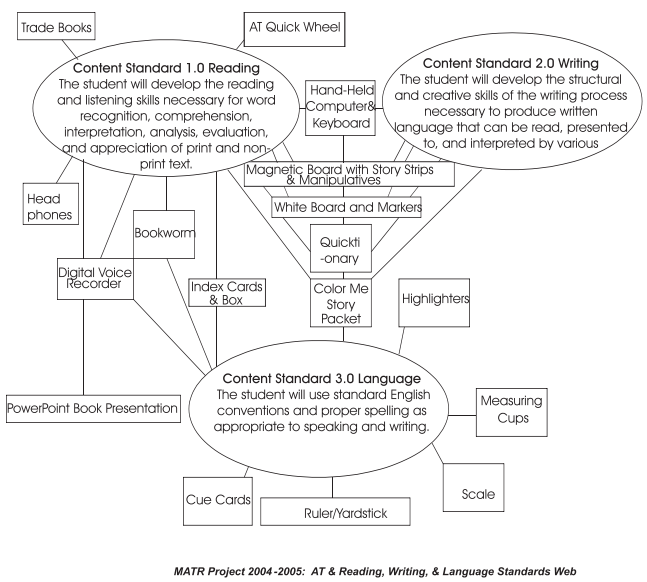

Figure 2. Assistive Technology and Tennessee Reading, Writing, and Language K-3 Standards Web

To evaluate the knowledge gained by participants, a pre- and post assessment were administered. The instruments consisted of items in five categories: reading, math, assistive technology, inclusion, and assessment. To determine how well participants performed on the pre- and post-assessment, the pre- and post-tests scores were compared using measures of central tendencies. Findings are presented in Table 1 for 22 participants who completed both the pre-and post tests.

It will be noted that participants' scores were consistently low on the pre-test, ranging from 41-46 percent correct responses, and consistently high on the post test, with 90 percent correct responses. Thus, participants' knowledge showed a dramatic increase from pre-to-post test results, thereby indicating that the goal to increase knowledge was attained.

In order to determine areas of growth, the scores were further analyzed by five categories: reading, math, assistive technology, inclusion, and assessment. Table 2

Measurement	Pre -Test	Post -Test
Mean	34= 46%	66= 90%
Median	33= 45%	66= 90%
Mode	30=41%	66= 90%

Table 1. Comparison of Pre- and Post-Test Scores

Rank	Category	Mean Pre-Test	Mean Post-Test	Difference
1	Reading	6.9	14.8	7.9
2	Assessment	6.9	14.4	7.5
3	Assistive Tech	7.3	14.5	7.2
4	Math	4.0	8.5	4.5
5	Inclusion	4.5	4.9	.4

Table 2. Comparison of Pre- and Post Scores by Categories

presents the mean pre-and post-test scores for each category.

The rankings indicate that the categories showing greatest growth were reading, assessment, and assistive technology. These rankings suggest that the three major areas of the project, reading, math, and assistive technology represent satisfactory growth. The high gains in assessment were likely due to participants' low level understanding of assessment at the beginning of the project. The area most in need of further development is inclusion.

In sum, the measures of central tendency indicate that project participants increased their content knowledge considerably over the time of the project. Further, participants showed important improvements in their understanding of concepts and strategies relevant to reading, assessment and assistive technology. It should be noted that participants fared especially well on their understanding of how to incorporate assistive technology into reading and math instruction, how to design integrated reading and math activities, and how to use assessment results to tailor instruction to the needs of their students.

Two other sets of data were collected to aid in evaluating the project: participants' evaluation of the MATR training and their assessment of expected outcomes. Each module was rated as excellent (E), good (G), fair (F), or poor (P). Regarding participants' evaluation of the training, responses were highly positive, as indicated by results presented in Table 3.

The evaluations of the workshops confirmed the impression that participants were enthusiastic and highly involved in the training sessions. It will be noted that presenters' knowledge, effectiveness of presentations, and presenters' responses to participants were highly regarded as indicated by participants' ratings of these areas as either excellent or good. Issue of critical concern was whether participants would actually implement strategies from the workshop. Most were either willing to try or felt confident that they would utilize the strategies. Interestingly enough, Module IV,

Evaluation Area	Module 1: Major Concepts	Module 2: Utilizing AT	Module 3 Diversity and Inclusion	Module 4 Standards -Based Teaching
Overall	E = 91% G = 9%	E = 100%	E = 100%	E = 100%
Presenters' Knowledge	E = 100%	E = 94% G = 6%	E = 100%	E = 100%
Effectiveness of Presentation	E = 95% G = 5%	E = 94% G = 6%	E = 100 %	E = 100%
Audience Response	E = 95% G = 5%	E = 100%	E = 100%	E = 100%
Readiness to Implement	E = 45% G = 55%	E = 39% G = 61%	E = 68% G = 32%	E = 68% G = 27% F = 5%

Table 3. Participants' Evaluation of the MATR Training

standards-based teaching, was the one that participants felt least ready to implement. The irony is that one would expect for teachers to be well on their way to use standards-based teaching in response to the demands for more direct instruction in teaching toward the state standards.

An important part of the evaluation of this project was participants' perceptions of how well the expected outcomes of the project were achieved. In one of the final feedback sessions, ten participants rated the attainment of expected outcomes. Each outcome was rated on a scale of 1-5 (5=high), yielding a possible 50 points for each item. Ratings were then added to compute a score for each item. Table 4 presents the results in order of highest to lowest ratings of outcomes attainment.

Given that the maximum score that could be received was 50, the scores for all items were relatively high. Two observations are worth noting. First, the item receiving the lowest rating had to do with Individualized Education Plans, a rating that might also explain the evidence that the category of inclusion showed the lowest rate of growth on the pre-and post assessment results. Second, the second lowest rated item, item 6, was not supported by the pre-post test results indicating high growth rates in the area of assessment. We can speculate that this

Item No	Outcomes	Rank	Score
8	Can incorporate assistive technology into individualized interventions and classroom practices based on assessment results	1	50
3	Can design effective literacy programs for inclusive classrooms	2	48
2	Can use theme -based literature to facilitate mastery of math standards	3.5	47
10	Can demonstrate the ability to integrate assistive technology into reading and math	3.5	47
1	Can critique different perspectives on assessment of young children's reading and math skills	5	46
11	Can demonstrate the ability to train others in the use of assistive technology tools as a medium and resource	7	45
12	Can facilitate school -wide efforts to integrate assistive technology into systematic Instruction	7	45
5	Can identify language differences in inclusive classrooms	7	45
9	Can facilitate amiable classroom environments to cultivate a community of learners who engage in cooperative learning	9	44
4	Is proficient in the use of assistive technology tools as a medium and a Resource	10	41
6	Can conduct competent, individualized and group assessments of students' strengths and needs in reading, math, and Technology	11	40
7	Can develop differentiated instructional plans to accommodate Individualized Education Plans (IEPs)	12	38

Table 4. Ratings of Expected Outcomes

discrepancy may represent the difference between knowing and doing, as participants tend not to feel comfortable with utilizing assessment results to inform instruction in reading and math.

Based on the results of the various assessment measures used in this project, one can say that the project was a success, participants showed growth in their knowledge from the beginning (pre-assessment) to the end (post-assessment) of the project; and, the expected outcomes were perceived as having been met by participants. Certainly, these results are supported by the enthusiastic involvement of the participants throughout the project. Indeed, most were saddened that the project had ended and expressed an interest in continuing it. In order to identify directions for continued work, it was important to identify the most and least successful aspects of the project.

The MATR Project was successful in a variety of ways. The quantitative results were supported by the analyses of participants' journal entries. The entries were extremely positive. As one participant put it, "MATR training has greatly improved my teaching, and made me feel more confident." Participants spontaneously expressed verbal commendations about the content throughout the project. Frequently noted was an appreciation for the hands-on strategy that was implemented for active engagement in the learning process. For instance, participants gained valuable experience during the allotted 'play time.' These sessions provided ample opportunities for explorations of the assistive technology devices included in the tool kits. Collaborative learning was facilitated as each school team conferred among themselves and then was encouraged to interact with the members of other school teams. There was also a large number of positive comments about the diversity and inclusion training that featured cultural competence with diverse populations. Multiple Intelligences theories, strategies to build an anti-bias, multicultural classroom library, and a showcase of culturally responsive children's books were deemed valuable information.

Multifaceted assessments indicated that the objectives were met. A pre/post assessment was administered to MATR participants. Results indicated that there was a significant improvement in the post assessment results. During performance-based assessments, participants demonstrated effective application of learning and a high level of proficiency with using the assistive technology devices. Notably, the professional development workshops that were designed and presented at participants' home school exceeded the requirements of the project.

For example, the use of a five step strategy for standards-based teaching in reading and math (Brinson & Scott, 2004) was presented in the module training. One of the school teams integrated the strategy into the professional development workshop designed for its school colleagues. Likewise, school teams utilized the strategy in their class teaching. Equally important, one school team involved its students in its workshops by having the

students, rather than the MATR team, demonstrate the use of the Bookworm, the hand- held computer, the reading pen, and the overhead calculator during a professional development workshop. Another school team presented the professional development workshop they designed at the Second Annual Reading Conference for the Restructuring Inclusive School Environments. A different school team conducted its professional development workshop for students in a graduate reading and a graduate assessment course. In addition, anecdotes and reflections included revelations and provocative insights about the integration of math, reading, and assistive technology. As one participant expressed it"I was thrilled to discover how math, supplemented with assistive technology, could increase reading skills," In this case, she was speaking of ways that her group had utilized the Bookworm to read the *Hershey's Milk Chocolate Bar Fractions Book,* followed by the display of numerical word wall depicting fractions.

One of the less successful aspects of the project was low participation of school administrators. Although concentrated efforts were made to actively engage school principals in the project (e.g., initial meeting with principals to provide MATR overview, outline expectations, receive feedback, and collaborate on school goals) there was low attendance at the performance management meetings that were designed specifically to confer with administrators at respective schools.

At times scheduling was problematic. The activities for MATR were originally scheduled around publicized school activities and individual school calendars that were provided by participants. Still, there were a few unforeseen scheduling conflicts. The rescheduling of activities also caused a few communication breakdowns. For example, although notifications of rescheduled events were disseminated to schools via written notices, e-mails, and telephone messages, as well as home addresses, one school team reported that two of their members were not aware of the schedule change. Few of the participants were able to enroll in the graduate courses that served to complement the information in the workshops and that were available with no charge to the participants. The main reason given for not enrolling was conflicts between scheduled school activities and course schedules.

Implications and Conclusion

The successes of the program suggest aspects of the project that should be continued, including the content of the module and continued use of such assistive technology devices as the Quictionary, the Bookworm, the talking calculators, and the math manipulatives. However, the growing body of information on ways of using computers as assistive technology devices warrants further consideration. The least successful aspects of the project were logistical in nature. Consideration should be given to offering more of the content via course work instead of workshops. Offering the information in courses has several advantages, including pre-scheduled meeting times that educators are accustomed to attending and the earning of college credits that can be used toward advanced degrees.

Perhaps the most important direction for continued work is the need to test the efficacy of using assistive technology in actual classroom settings. The incorporation of action research into the model is ideally suited for an assistive technology project. Participants would be able to put their intuitive judgments about positive learning outcomes to an empirical test in their classrooms. Participants would therefore be able to draw upon existing research to inform their action research. As the above discussion of the evolving research demonstrates, the methods of research on the uses of assistive technology to differentiate instruction has already begun to show promise.

Finally, it would be useful to move the same participants through advanced phases of the project. Using information from this study, phase II of the model is now being implemented. For example, in phase II, participants were enrolled in two courses, and only one set of workshops is offered to help participants plan and implement professional development in their school districts. The authors anticipate another round that will include action research, but what is lacking is, a single

group that can move through each of the three phases, a move that would represent a marked improvement in capacity building from novice to expert levels of performance that will better lend itself to train the trainers dimension of the project.

As explorations continue, modifications are made. The constant is our view that leaving no child without the support needed to maximize their learning potential must begin with teachers and other instructional staff. After all, student support begins and ends with teachers who feel confident about their knowledge and skills and who experience success in the use of assistive technology as a means of improving student learning.

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