Components of Research:

Computer Technology Use and Mathematics Achievement

A Plan for Research Regarding the Effects of Computer Use in Mathematics Instruction with Emphasis Upon Low Achievers

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Statement of Problem

Does the use of computer technology increase students’ learning and academic achievement in the area of mathematics, particularly among those students with learning disabilities? To determine the justification for using a computer based intervention, the following paper seeks to examine some of the extant literature surrounding this topic, what correlations have been found, positive or negative, and to propose new research which may be carried out in order to further refine information useful to instruction.

Hypothesis

This study will seek to show that a positive exists between the use of computer based instruction and student achievement in the area of mathematics.

Published Studies

In an effort to obtain guidance in carrying out the proposed research related to whether computer based instruction can improve achievement in mathematics for the proposed population, a review of some of the previously published literature has been conducted. Although the findings have been contradictory, one aspect stands out. It appears that computer usage alone is not relevant to raising achievement levels. It is more important to consider how the technology is employed. A great deal of the available literature has been reviewed, however, in order to examine a manageable sampling of the findings within the limits of this paper, three studies have been chosen to present here.

The first study to be examined was published in the Research in Higher Education Journal, based upon TIMSS 1999, also known as TIMSS-Repeat, was the second administration of IEA’s Third International Mathematics and Science Study. The assessment was designed to provide trends in eighth grade mathematics and science achievement in an international context. TIMSS 1999 was conducted by the TIMSS & PIRLS International Study Center at Boston College and included 38 countries. The 1999 assessment measured the mathematics and science
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achievement of eighth-grade students (ages 13 and 14 years) and collected extensive information from students, teachers, and school principals about mathematics and science curricula, instruction, home contexts, and school characteristics and policies. In the United States, the TIMSS 1999 Benchmarking Study included 13 states and 14 districts or consortia of districts from all across the United States. The TIMSS 1999 assessments were administered to representative samples of eighth-grade students in the districts and states in the spring of 1999, at the same time and following the same guidelines as those established for the 38 participating countries. In addition to testing achievement in mathematics and science, the TIMSS 1999 Benchmarking Study collected extensive information from students, teachers, and school principals about mathematics and science curricula, instruction, home contexts, and school characteristics and policies.

An important point made in this article is that feedback and reflection for understanding is indeed an important instructional tool for teachers. Technology dramatically reduces the time required for teachers to provide this essential feedback to students. Other studies have pointed to the importance of timely feedback.

The conclusion of this research is that in the United States, the relationship between technology and achievement is statistically insignificant and negative, and that technology is improperly used. Other countries, including Singapore, have had a significantly positive relationship manifest as a result of more proper use. In analyzing the data, a statistical/empirical approach was used, and included descriptive analysis statistics, Pearson correlation coefficient, analysis of variance and multivariate analysis of variance. Differing methods were used due to the fact that in some cases there existed more than one dependent variable. Validity appears to exist in view of these considerations being given.

A second article, by Schacter and Fagnano (1999) indicates similar findings within the United
States using meta-analyses on Computer Based Instruction. The meta-analytic research combines data from multiple similar single research studies to generate a single effect size coefficient that illustrates the treatment effect across all the studies. In examining such a large number of studies, the findings could be generalized, and in so doing, lend validity to the report. The data indicates moderate positive gains that show that the students who engaged in Computer Based Instruction performed significantly better than students who did not. The authors point out that the ease and efficiency provided by technology does not necessarily promote deep and meaningful learning. The Computer Based Instruction must be based upon sound learning theory and pedagogy in order to have a pronounced, positive effect upon student learning/achievement. The article further includes some of the prominent learning theories and how using these can be powerful and transformative.

A third article analyzed comes from the *International Journal of Behavioral Consultation and Therapy*. The research used a multiple baseline design to evaluate the effects of a Detect, Practice, and Repair (DPR) instructional procedure to examine multiplication fact fluency. The study focused upon 10 low-achieving 5th grade students. Experimenters in the study modified the DPR procedure using computer technology to allow for more rapid self-evaluation in order to identify target facts to be internalized for greater fluency. Next, another procedure, cover, copy, and compare (CCC) was used only on the problems answered incorrectly. Increased baseline data (maturation) hindered interpretation of effects for a third procedure. This issue could be a positive aspect in terms of validity, as it is desirable to limit the number of treatments in an experimental study. The authors pointed to literature on theories that individuals have limited cognitive capacity and automatic responding is thought to require fewer cognitive resources, including working memory and attention. Those who expend too much of their cognitive capacity performing basic computations may have insufficient capacity to apply toward
acquiring complex mathematical operations. The article also points to another study involving
the use of DPR to increase subtraction-fact fluency in 14 low-performing students who were
receiving special education services. The research showed significant increases, compared to the
district-wide averages. Another study of DPR effectiveness was found in enhanced division-
fact fluency in middle school students in 2009. Three limitations were examined for the studies.
Results indicated that computer technology use was a positive factor in increasing achievement.
Because the procedures were well outlined, results replicated, and limitations examined with
suggestions for compensation, the research should be considered valid.

**Proposed Research Plan**

Although the current research proposal is still in the planning stages, some of the components
of the proposed research will be outlined in the following pages.

**Interviews with Professionals**

In order to glean information from professionals with access to data collected, some personal
interviews will be conducted. Three candidates for this line of research are Dr. Mark Jones,
Division Superintendent of a rural Virginia school division, Dr. Sheila Carr, Director of Special
Programs for the same school division, and Cindy Hyman, Vice President, Cortez Management
Corporation in Hampton, Virginia. These professionals have many years of experience. One
can provide information and statistics which exist relative to the benefits, if any, of instructional
technology employed by an entire school division on the performance of students in all grades
and categories. The second professional has data related to the benefits, if any, of the use of
instructional technologies employed by the school in the narrower category of Special Education.
The third professional has information at hand as to the effects of instructional technology used
in a variety of student populations so that the research findings will contain a more balanced set
of findings on a larger scale.

Moreover, these interviews will produce information as to what, if any, documented
research exists relative to a particular school division. The present assumption is that there
indeed is documentation of such data in existence. Additionally, all of the chosen professionals are in a position to point to outside studies in other divisions as well, assuming that such studies were used to make decisions for their school division in terms of purchasing technologies and funding professional developments to improve teacher facility and to increase the use of the purchased technologies.

**Sample population**

For the proposed research project, there are some key characteristics desired for the sample population. Some of these key characteristics include students in several categories including students with learning disabilities and/or intellectual deficits (average to mild general learning disability). The table provided below outlines the Wechsler Intelligence Scale. This particular scale has been chosen because it may better evaluate students with ADHD (Attention deficit/hyperactivity disorder) and other behavior disorders than some other instruments which measure intelligence (Minddisorders, 2010).

**Wechsler**

<table>
<thead>
<tr>
<th>Scale Score IQ</th>
<th>Intelligence Range/Special Ed Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>130 and above</td>
<td>Exceptionally Able/Gifted</td>
</tr>
<tr>
<td>90-110</td>
<td>Average (not a special education category)</td>
</tr>
<tr>
<td>70-79</td>
<td>Borderline General Learning Disability</td>
</tr>
<tr>
<td>50-68</td>
<td>Mild General Learning Disability</td>
</tr>
<tr>
<td>35-49</td>
<td>Moderate General Learning Disability</td>
</tr>
<tr>
<td>Below 35</td>
<td>Severe/Profound General Learning Disability</td>
</tr>
</tbody>
</table>

Poor past achievement scores in the area of mathematics is also a requirement for the sample groups to be used. The sample population also must have adequate access to instruction using computers delivered by instructors with adequate training and competencies in using the computers, as well as competent, readily available technical support staff. The sample population must also contain parental and administrative support for the use of instructional
methods employing the use of computers tools. The concern here is to reduce the possible threats to both external and internal validity as much as is practicable. The intent is to establish a cause/effect relationship between the use of computer based, or computer assisted instruction and student performance, in which case the sample groups must be carefully selected.

**Challenges and Solutions**

One challenge which could be encountered in accessing the sample population for the proposed population is that of timing. If the research is carried out far enough in advance of high stakes testing season, the chances may be better of finding adequate participation. If the research is carried out after the mandatory testing season, there may not be enough effort put forth by the participants to render the results valid or reliable. Another challenge to accessing the desired sample population may be finding instructors who are willing to try experimental methods, or simply methods which differ from their customary pedagogy. This challenge might be successfully circumvented if enough data is presented to indicate that the proposed alternative methods have been successful in the past. Still another barrier may be finding a number of sampling groups which have access to the technology and instructors who feel confident in their ability to use the technology effectively, or enough technical support should technological issues arise. These issues would have to be attended to in advance in order to provide the instructors with assurances of support. In addition, parental support cannot be taken for granted and must be secured prior to commencement of the research. Otherwise, the project is at risk of the findings being rendered invalid due to mortality. The researcher will want to control for confounding variables to the greatest extent possible in advance of commencement. Prior planning will ensure that anticipated issues are addressed in advance to avoid delay in the proposed project.
Using surveys

Some advantages to using a survey to collect data exist. Surveys can help the researcher to obtain a much more in-depth picture of concepts or situations which affect the data obtained from more quantitative, objective results such as those provided by test results or results of methodologies used in achieving some end(s) or product(s). Surveys can shed light upon how or why other data manifests. Use of such tools can explain more clearly how other data occurs, and/or under what conditions. Surveys can answer questions which researchers may have that objective, quantitative data cannot. Surveys can also be constructed in such a way as to pinpoint exact questions which the researcher is seeking to have answered. Furthermore, surveys can be used in a myriad of ways to collect data which an objective test cannot.

Some limitations of the survey method are also present. One such limitation is the degree of participation. The request may be made of respondents, but there is no guarantee how many desired participants may actually respond. There is also no way for the researcher to be certain how exactly the participants will approach their answers, or whether there had been any confusion related to the survey questions asked. In the case of the Likert scale, there exists a very large margin of error, both in answering the questions and interpreting the results.

Ethics in Survey Data Collection

One of the foremost considerations in ethics related to survey research is that of anonymity. The researcher must make it clear whether or not participants can or will be identified, or whether all respondents will remain completely anonymous. Researchers must be scrupulously ethical with this aspect of the survey. No breach of this code is acceptable. One way to ensure that this standard is met is to devise a method of survey collection which would leave no possibility of participant identification. To proceed otherwise would be to forfeit the opportunity of complete honesty/validity of the responses.
A Proposed Survey Instrument

A survey composed of, but not limited to, the following queries may be used:

1. Mark with an (x) the choice which best describes you:  (   ) male   (   ) female
2. Years in school ______
3. Current grade level ______
4. Years in this school division ______
5. Is there a computer in your home (   ) yes  (   ) no
6. Do you have an internet connection  (   ) yes  (   ) no
7. Do you currently use a computer in class for math?  (   ) yes  (   ) no
8. Do you currently use a Smart Board in class for math?  (   ) yes  (   ) no
9. Does your teacher use the computer for teaching you new concepts in math?
   (   ) yes (   ) no
10. Does your teacher have you use the computer to practice skills in math? (   ) yes  (   ) no
11. Do you use the computer to play math games? (   ) yes (   ) no
12. Does using the computer help you understand the math lessons? (   ) yes (   ) no
    (   ) not sure
13. Are you good at math? (   ) yes (   ) no
14. Do you enjoy math class? (   ) yes (   ) no
15. Would you like to improve in math? (   ) yes (   ) no

Method of Administering the Survey

In order to increase the chances of validity of student responses, they must understand that
the survey itself is not a test. Small group explanation of the survey, its purpose, and contents
should be utilized. The importance of the survey should be emphasized, and it should be made
clear to the students that there are no “right” or “wrong” answers, merely that an honest
response should be given to each item. The survey itself should be administered according to
the needs of the population of each small group. For instance, if some of the students have
instructional accommodations these must be adhered to in order to ensure that the students fully
understand the proceedings and the actual questions themselves. If the survey is to be an
anonymous one, then there will need to a an additional support staff member available for
assisting with accommodations. Adults responsible for such support must ensure that a friendly,
relaxed tone is set for completing the survey.
**Qualitative Research Studies**

Consideration for using qualitative approaches to the current research has led to a review of some of the extant literature. The findings reported in three journal articles will be discussed here, as well as comments upon the approach used and the validity of each. In terms of validity, the literature will be examined to determine the degree to which the studies and data they present accurately gauge what the authors are trying to measure (Gay and Mill et al, 2012).

The first article examined was published in 2011 (House and Telese, 2011). In this qualitative study, a large sample was taken from eighth-graders in the United States (6,809), as well a large sample of same grade students in Korea (4092). The study was carried out to determine the levels of motivation for the eighth grade students. It was determined that several specific computer activities and classroom lesson strategies were significantly related to motivation for learning mathematics in both countries. Surveys and interviews were conducted. A two-stage stratified cluster sample design was used, as well as multiple regression procedures.

The findings indicated that students from both countries who frequently used computers for schoolwork in mathematics also reported that they enjoyed learning mathematics. However, students from both countries who indicated that they spent more hours per week using the Internet outside of school were less likely to enjoy learning mathematics. Further, students in the United States who frequently engaged in cooperative learning activities and in activities which were directly related to real-life situations tended to enjoy learning mathematics. These activities did not show significance for students in Korea. The students in Korea who frequently explained their answers during lessons enjoyed learning mathematics, but that relationship was not found to be significant for eighth-grade students in the United States.

Due to the large sample size, and to the appropriate use of statistical tests of significance used to produce unbiased variance estimates, the studies should be considered to contain valid
assessments. The studies also produced similar findings to other studies on student motivation. The results indicate that the data collected clearly measures what the researchers aimed to measure.

A second study examined was published in the *World Academy of Science, Engineering and Technology* (Cnturk-Gunhan and Bukova-Guzel, 2010). The purpose of this qualitative study was to determine views of primary student teachers views related to the use of instructional technology and to reveal how presentations towards different mathematical concepts affect their views. Twelve subjects were selected from a public university. The subjects were selected using the purposeful sampling method, and included 6 females and six males. Data was collected from two semi-structured interviews containing the pre-interview and the post-interview. Three open-ended questions were asked, along with an additional question during the post-interviews. The interviews were recorded and transcribed verbatim. Coding was then applied and evaluation was guided by accepted ideas in qualitative content analysis. Interpretation and discussion of the results was offered.

Findings from the study showed that the views of the student teachers changed during the process and that by the end, they believed that instructional technology should be incorporated into their classroom lessons. The student teachers concluded that instructional technology tools can gain higher skills and constructivist learning environment.

Although the sample was fairly small, only twelve subjects, the conditions were controlled. Full discussion as to the analysis procedures, complete with narrative and visuals in the form of tables were included. Validity should be considered sound for this report, as the research is able to accurately measure what it set out to measure.

A third article examined was a report of a qualitative investigation completed in Gaziantep, Turkey under the auspices of Gaziantep University (Yildirim and Demir, 2010) and published
in 2012 by the Cukurova University. The authors state that a case study method was used to enable a more profound examination on exceptions without any need of generalization or proving. The study was carried out during 20 course hours with an entire class of students in 10th grade in the Gaziantep province. Its authors point out that while limitations include the fact that only one teacher’s practices used in the study, the results are important because they are based upon in-class observations and video records. The aim of the study was reported to be to figure out student ideas about technology supported instruction as well as alternative measurement, when the two are used together.

Data collection consisted of student interviews conducted with each student separately at the end of the process which included the use of technology coupled with further use of alternative assessment methods used throughout the course. The students were asked two questions designed to assess the difference in the course taught normally, and with the course taught aided with technology and alternative assessments as these things related to their interests, their feelings about the course, how well they comprehended, their success levels, and ability to memorize what they had learned. A question about their feelings about assessment was asked to determine which they thought was more effective: one test given at the end of the course, or alternative assessments given throughout the course. Codes and tables regarding students’ opinions were generated and included in the article.

In reporting results, some other studies were included. All the studies reported results pointing to the use of technology significantly increasing students’ achievement and positive attitudes towards mathematics. Results also included more correct demonstration of students’ achievement when alternative assessment tools were used. In the current study itself, findings included increased student interest for the course, and greater participation and success was observed. Learning was positively affected by use of technology. The students felt that the
alternative assessments reflected their success more accurately, specifically, these assessments gave them more time to respond and the structure was not so overwhelming that they felt that they had forgotten what they learned.

The study appears to a valid study based upon the definition of validity in regard to qualitative research. Conclusions made successfully satisfy the aims of the study.

**Challenges in Obtaining Interviews and Solutions**

Obtaining interviews for the proposed research may present a number of challenges. One such challenge would almost assuredly be obtaining the required written parental permissions in a timely manner if the researcher waits until the onset of the project to do so. This setback could be avoided by simply securing the permissions at the start of the school term when the parents/guardians will be coming in for other meeting purposes. The plans could be discussed at that time in a relaxed manner, so as to clarify the possibility of the research taking place at some point during the year. The parents would be free to ask any questions or address any concerns while they are already present to discuss it and either grant permission on the spot, or at least have information with which to make a decision in the near future before the time arrives. Another challenge might be securing uninterrupted time for interviewing the participants themselves. This too, may be successfully addressed through thorough prior planning well in advance of the anticipated project start date.

**Reasons for and/or Goals of Using a Qualitative Interview**

An important reason for conducting a qualitative interview is that it allows the researcher to obtain important data which could not be acquired through an observation alone. Another important reason to interview subjects is to follow up in more detail some aspect which was noted in the observation. It can be a useful tool in understanding an observation. In-depth information can be obtained in an interview as to the subject’s experiences, feelings, attitudes,
interests, values, and concerns which would not be apparent through observation. The interview also affords the opportunity to explore these ideas individually.

**Advantages of the Qualitative Interview**

One advantage of employing the qualitative interview is that it allows the researcher to observe and record a subject’s unique experience or perspective as to how they relate to a certain issue or issues. The questions are open-ended without the expectation of right or wrong answers. This stressful condition does not exist here. The session can be conversational and relaxed which should produce more genuine, honest results.

**Disadvantages of the Qualitative Interview**

Quantitative interviews require more time that quantitative data collection. This method may be more reactive to personalities, moods, and interpersonal dynamics between the interviewer and the interviewee than methods such as surveys. It requires skill and practice to effectively collect data using this method.

**Ethics in Qualitative Interviewing**

Ethical issues are present in any kind of research. The research process creates tension between the aims of research to make generalizations for the good of others, and the rights of participants to maintain privacy. Ethics pertains to doing good and avoiding harm. Harm can be prevented or reduced through the application of appropriate ethical principles. Thus, the protection of human subjects or participants in any research study is imperative. In the proposed research, ethics should not present as an issue, or a least not of the magnitude which might be present in say, medical or psychological research. However, the one ethical issue which is a standout in most all areas of research is that of anonymity. With regard to the qualitative interview, subjects must be assured that what they share will be kept separate from their identity.
**The Case for Not Employing Experimental Methods**

Most experimental design does not take into account the all-important aspects of motivation in student achievement, nor does it consider self-efficacy which has been proven to have far greater impact than any other aspect of achievement. It usually focuses upon more quantitative forms of data and assessment. To proceed in this manner leaves out a vast amount of proven methodology in the interpretation of student achievement. Further, for the population at which the proposed research is aimed, traditional methods of assessment do not produce valid results in terms of what the students actually know or can do, given the constraints of the assessment methods typically used in experimental research. Moreover, such assessments do not indicate whether the knowledge gained through instructional activities can be used or transferred to other settings. The target population is one in which the subjects do not perform well on rigid, objective types of assessments conducted under laboratory conditions. In addition, experimental methods of collecting data can also be confusing to subjects who perform best or are only able to function under routinely predictable conditions. Another limitation is that experimental research tends to focus upon predetermined variables to the exclusion of the myriad of variables which actually exist.

**10 Qualitative Questions**

1. How do you feel about math class?
2. Do you use what you learn in math class in other situations?
3. What helps you most in understanding ideas in math?
4. Do you have a computer at home?
5. How do you use the computer at home?
6. Do you use the computer to practice math skills? If so, what do you do?
7. Does using the computer at home help you with math?
8. Does it help you when your teacher uses the computer to teach you math skills?
9. How often do you use a computer to practice math skills?
10. If you could change anything about math class, what would it be?

**Reasons for the Questions Chosen**

These questions have been developed in order to gain insights into the subjects’ attitudes and
habits with regard to mathematics. This information can provide insight into whether the subjects view mathematics as valuable as well as what they perceive to be instrumental in having a positive impact upon their achievement. Whether or not their own perceptions are accurate is not in question, but the subjects’ perceptions are important in determining the validity of the outcome of the research, as well as determining future directions for instruction and further research. Knowing how the subjects view mathematics and having insight into perceptions and habits will be telling to the researcher in terms of how things currently exist, and how future instruction may be shaped to meet the needs of the population under study.

Methods

It is proposed that the interviews be conducted on an individual basis to elicit more authentic responses than would be obtained in a group – interview response. This is also in keeping with the ethical consideration of privacy. The interviews should be conducted in a tape-recorded session which should be made clear to the subjects prior to commencement. Some recordings may be made as practice prior to the interview and played back to familiarize the subjects with the procedure and to alleviate anxiety or to create a comfort level.

In interpreting the data, the subjects will be given the opportunity to listen to a play-back, as many times as desired to confirm accuracy of responses. Editing may be done if the subject so desires. Once a final audio version is approved by the subject, the researcher may then draft a hard copy of the interview, perhaps in a summary or paraphrased format. Once this is accomplished, an outside observer will be employed to review the audio version in order to compare it to the written summary and gauge it for accuracy. Differences of opinion will be analyzed to reach consensus. In the final stage, the completed written documentation of results may be presented to the subject once more for approval.
The Case Study

The case study is a form of qualitative, descriptive research that is used to look at individuals, a small group of participants, or a group as a whole. Researchers collect data about participants using participant and direct observations, interviews, protocols, tests, examinations of records, and collections of writing samples. It is a method which provides rich descriptions in authentic, natural settings. The case study provides in-depth information not only about the topic, but also about underlying facilitators and barriers which may exist and affect the question of interest. The case study often turns up variables which were not even known to exist at the onset of the research. Some case studies which are relevant will be discussed here.

In 2005, Garthwait and Abigail published the findings of a study in the Journal of Research on Technology in Education which described and reported findings of a case study involving two seventh grade teachers. In terms of methodology, the theoretical basis for the research was said to be phenomenological inquiry which uses a naturalistic approach to “inductively and holistically understand human experience in context-specific settings (Patton, 1990).” The researchers report that while acknowledging the value of survey and interview data, they set out to verify those data with case study classroom observations. The interpretive study took place in Maine, the first state to fund putting laptop computers in the hands of an entire grade level of students, as well as their teachers. Using qualitative methods, the researchers collected data during the first year of the Maine Learning Technology Initiative (MLTI). One of the areas they hoped to uncover data concerned the educational effect of technological policies.

Two math-science teachers were chosen. The criteria for selection for the study included: they must be actively involved with the MLTI project, teach math-science, and be willing to be a part of the research. They also went a step further in that the school itself had to fit two requirements: it had to be within reasonable commuting distance due to the large amount of
observation time, and the school had to be a typical school that did not stand out in terms of extremely high or low achievement scores, socioeconomic base, or funding. They eventually settled upon a middle school whose average student standardized test scores were close to the state averages across all subjects for at least three, most recent consecutive years. The ethnic composition of the rural area was also similar to that of the state. This selection criteria process should be noted a point of validity for the study.

In November, they held a meeting with the principal for the purpose of securing access to the school and obtaining information as to the understanding of administrative support. The study continued until June. The following year in May, the two participants were contacted for follow up. There was one male teacher and one female teacher selected.

According to the article, the interviews used in carrying out the research were characterized as “guided, semi-structured or semi-standardized.” Each of the researchers asked pre-determined questions and broached several topics. The researchers departed from the pre-determined questions to probe deeper, as responses warranted. The participants were encouraged to add additional reflections, opinions, or comments that had not been formally a part of the original set of questions. The researchers took field notes of classroom observations and expanded upon these notes as soon as possible after the observations and coded them into emerging categories of interest. The researchers also used inter-rater agreement, which was reached in reviewing this data, also a point of validity.

The researcher used multi-faceted data content analysis which included audiotape transcription, coding artifacts, observations, and interviews. They would then come to agreements on the selection criteria, and the categories or domains for each subject topic. They disaggregated the data and categorized them. The categories included technical skills levels, modes of instruction, use of computers in the classroom, professional development, construction
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of units and curricular planning, and instruction. Later more components were added, including assessment of student work, the value of MLTI, school policies, and affective comments. The researchers report that they used inductive analysis as they read and discussed the data collected. They also searched for underlying patterns. Again, these procedures lend validity to the study.

The findings of the research were positive. Both subjects had a positive view of the educational potential of using the laptops in computer assisted instruction. The male held a Master’s degree in Instructional Technology. The female had recently enrolled in a graduate course for using laptops for middle school math prior to the implementation of MLTI. She offered up ways that many of the artifacts in her room could be enhanced and less space consuming by using the computers. She further indicated that the computers could offer more high quality content than the “watered down” textbooks, as well as giving access to more up-to-date information. She also noted that the use of the computers would give the students greater access to state learning standards. In addition, she reported how the computers offered the opportunity to more individualized instruction. She mentioned how several of the students appeared less “needy” when using the computers, and that most who typically did nothing with material presented were far more engaged. The female teacher also reported that she had to be quite critical in selecting sites for quality. She noticed that there was an enormous difference in student’s willingness to think through conceptual mistakes and make needed changes in their work when using the laptops. The male teacher noted that his students were far more creative when using the laptops. He also noted that quality teachers know that how to harness the energy of a group of students and motivate them to learn through allowing them to discover that learning can be fun, which can easily be done through actively learning and games in the classroom. He also noted that even his most challenged students loved projects that involved the use of the laptops as opposed to the paper/pencil instructional activities. In short, both teachers reported greater
involvement on the part of the students, and greater motivation. It has been the observation of this researcher, greater motivation and greater individualized instruction equates to greater achievement. In addition, the study revealed the idea that teachers have noted that the use of computers contributes to constructivist pedagogy.

The authors of this case study noted that although case study research does not necessarily generalize to the population of middle school teachers globally, it may very well serve as an opportunity to provide reflections useful to any teacher who is questioning the role of the use of computer assisted instruction. It may also inform administrators as to the specific associations of schools’ organizational characteristics with regard to the use of computers by their teachers.

Another more brief article published online in 2013 concerning computer assisted instruction used in instruction for students with attention deficit hyperactivity disorder (ADHD) indicated that each student considered in the case studies made significant performance gains among the students who were struggling with math. The case study was relatively small, involving only three elementary students in a controlled situation. In addition, there was no follow-up to the study. Additionally, behavioral observations were only conducted when the students were working with computers, and thus, provided no information about whether the increases in active engagement was limited to computer assisted instruction, or whether this would have occurred during other types of instructional activity. There was no information available to indicate whether data pointing to increased engagement or any other benefits were long-term, or simply due to novelty. For these reasons, validity would be in question. But, the real purpose of the report was to inform teachers, therapists, councilors, and parents about the actual research done by others which would benefit from the findings in working with children with ADHD. In summary, this article, published by Ashley Children’s Psychology Center of Northridge, CA was more of a commentary, written in layman’s terms, on a study done by Mautone, Dpaul, and
Jitendra in 2005, in the *Journal of Attention Disorders*. However, it does provide a good overview of the findings. The actual case study itself is sited at the end of this paper to provide the reader with its source. In reading the case study by Mautone, et al, one finds the clinical data contains the components of a **valid** case study, and supports the assertions made in the article.

**Challenges in Conducting Case-Study Research**

While case-study research provides thick, rich data gathered from authentic sources, it is not without challenges. Case study research has been criticized due to a perception that it cannot be generalized (Gable, 1994). But some common themes might emerge that would render the findings of the study informative for use in other situations or with other individuals. Another challenge present in the proposed research is the involvement of the researcher who would also be the instructor. This may produce issues with bias, and rigor may come into question, as the setting will be one in which individualization of instruction is not only possible, but carried out on a regular basis. While such individualization is generally viewed as a positive, it can also be a stumbling block in attempting to establish objectivity for the purposes of research. Great care will be required in the planning of methods, and in carrying out the instruction in order to keep pedagogy in line with research methods.

**Purposes and Objectives of the Case Study**

One of the goals of the proposed research is to determine whether computer assisted instruction produces any marked improvement in student achievement for middle school students with learning disabilities. Students with diverse needs would present different varied circumstances which would make rich, descriptive data more useful in interpreting outcomes, as well as informing future methods of instruction. The later, in turn, is a second purpose for the research. In addition, a goal of the study is to determine what types of computer technology and which methods of employing it are the most advantageous.
Advantages and Limitations of the Case Study

Case studies enable well informed reflection to focus on single issues, events and circumstances. They allow for entering the experience of others but with the privilege of then standing back and evaluating. The table below shows some specific relative strengths of case study and surveys as presented by Gable in 1994.

<table>
<thead>
<tr>
<th>Relative Strengths</th>
<th>Case Study</th>
<th>Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controllability</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Deductibility</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Repeatability</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Generalisability</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Discoverability (explorability)</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Representability (potential model complexity)</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

There are of course, some limitations involved in case study research. For example, the way in which tapes or notes are transcribed and analyzed can only give a limited perspective on the truth. The researcher bears the main responsibility for analysis and presentation of findings.

Another potential limitation is the large volume of data which is likely to be collected. While large volumes of data may be an advantage in some circumstances, it may become unwieldy in the case of the single researcher attempting to answer one or two pertinent questions through research.

Ethics in the Case Study

Consideration of ethics in this particular research study, as well as any study poses one of the first and foremost issues of research. This issue would be confidentiality. Great care must be taken to ensure the confidentiality of sensitive data collected on each and every participant.

One way to address this issue is to keep files secure, and to label any information artifacts as “confidential” which are not intended for viewing by non-essential, or unauthorized individuals. Great caution must also be exercised in discussions with subjects/participants and other research
Summary

This body of research proposes to target special needs students who are typically low achievers in the area of mathematics. Goals of the research include finding what disabilities cause difficulties in which areas of mathematics, and what methodologies (for example, traditional methods, computer assisted instruction, or a mixture) provide the greatest levels of improvement and success for the targeted population. The research will employ a mixture of methodologies in collecting and analyzing data in the hopes of providing valid results which can inform future instruction.
References


