RESEARCH OVERVIEW AND QUANTITATIVE RESULTS

Programming Remediation and Intervention for Students in Mathematics

Final Report
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INTRODUCTION

Since 2004, the Ministry of Education in Ontario has released a number of documents directing efforts to ensure the success of all students from grades 7 to 12. Leading Math Success acted as the impetus for this research project and provided an opportunity to pilot some unique resources and take on some significant challenges. Identifying students experiencing difficulty in mathematics is relatively easy. Developing and delivering programs to meet the needs of those students is more difficult. The Leading Math Success expert panel recommended that the Ministry of Education work with other education partners “… to develop, where necessary, and deliver research-based intervention programs for students at risk in mathematics” p 54.

The intent of the PRISM project was to use existing research-based programs with students experiencing difficulty in mathematics in order to provide learners with an opportunity to experience some degree of success in mathematics. A professional development plan was instituted for teachers in order to help them re-think how math is learned and taught. Three relatively new resources designed to help educators approach the teaching of mathematics in a different way were used; Prime, researched by M. Small from the University of New Brunswick, Canada and published by Nelson Canada; First Steps researched and developed by S. Willis, W. Devlin and others under the auspices of the Department of Education in Western Australia and published in Canada by Pearson; and Knowing Mathematics, published by Houghton Mifflin, which was designed by Liping Ma and Cathy Kessel. A brief description of each resource is presented in Appendix 1.

All three resources were based on years of experimental work directed at exploring how children learn math. The conclusions led to the realization that children learn mathematics in a predictable, somewhat sequential way. In the cases of Prime and First Steps, teachable skills, knowledge and conceptual understandings of mathematics were plotted alongside predictable, developmental continuums. Through in-service training and classroom support, teachers learned to recognize stages of development, and apply and adapt teaching methods to move students along the developmental continuum. Knowing Mathematics was designed as an intensive, prescriptive remediation program for students experiencing significant problems with mathematics.

Although all three resources were built on a solid foundation of research, several questions arose regarding the application of these resources in an Ontario context. Some of the questions are presented below. It should be noted that the intent of this project was not to review the actual resources themselves, but rather to examine the effectiveness of building of a professional learning community using these resources as a catalyst for
introducing a different approach to the teaching of mathematics. The premise of the project rested on the assumption that “...improvement of students’ learning depends on skillful teaching, and that skillful teaching depends on capable teachers and what they know and can do” (Ball, Bass and Hill, 2004).

**Research Questions**

The research questions generated by this project were divided into the following three main areas.

**Intervention and Remediation Programs**
- What are the characteristics of successful intervention/remediation programs (e.g., in-class support delivered by the regular classroom teacher, limited withdrawal in small group setting)?
- For whom do intervention/remediation programs appear to work best for and why?

**Teacher Professional Development**
- What are teachers’ understandings of developmental continuums in mathematics?
- How does the use of a developmental continuum influence teachers’ practice?
- How do in-class instructional/assessment practices change following the introduction of a developmental continuum?
- How does explicit instruction in mathematics pedagogy effect teacher practice?
- What are the experiences and key understandings of school leaders who implement the key components of the PRISM project using a Professional Learning Community model?
- What are the experiences and key understandings of teachers who implement the key components of the PRISM project using a Professional Learning Community model?

**Student Achievement**
- How does student achievement in mathematics change as a result of teacher practice?
- What are the factors that influence how quickly and successfully a student can be moved along a developmental continuum for mathematics?
**METHODOLOGY**

**Participants**

An overview of the modified Research Framework is presented in Figure 1. The original design called for a total of 132 teachers, however that number was considerably reduced by the conclusion of the project for a number of reasons. One of the main reasons centered on time lines. It appeared that longer time lines were needed to ensure that participating teachers could arrange adequate supply coverage for the days they were absent from school. Similarly, several teachers who initially expressed an interest in the project were unable to participate because of competing demands on their time. In addition, some teachers did not fully understand the degree of commitment required for the project until the first meeting and thus opted to discontinue participating at that point. Three teachers, upon hearing the purpose of the project, felt they could not benefit from the in-service training. A final group of teachers were unable for various reasons, to complete the project (e.g., health issues, school transfers, late return of information).

Figure 1: Modified Research Design
Teachers

A total of 57, grade 7 and 8 teachers from three boards of education from Eastern Ontario and 1 from the central region of Ontario participated fully in the PRISM project (see Appendix 2 for Letter of Information to Senior Administration and Principals of participating schools). Twenty-three of those teachers received 3 days of in-service training on the use of a developmental continuum, either Prime (Nelson Publishing Company) or First Steps (Pearson Publishing Company). Further to the developmental continuum in-service, 4 teachers received an additional 3 days of training in a specific program designed for at risk students (i.e., Knowing Mathematics), and 13 teachers received in-service training on Knowing Mathematics only (Houghton Mifflin publishers). All teachers in the active group (i.e., Prime, First Steps, and Knowing Mathematics) received an additional 2 days of release time to become actively involved in a professional learning community focused on the teaching of mathematics.

The remaining 17 teachers did not attend in-service training in Prime, First Steps or Knowing Mathematics and they, along with their students, served as controls. Teachers in the control group were made aware of the possibility for in-service training during the 2005-2006 school year. It should be noted that resource and special education teachers, as well as, regular classroom teachers were invited to participate in the project.

For the purposes of this report, the type of in-service training will designate group membership. “Prime” will refer to teachers that took the Prime in-service training; “First Steps” will refer to teachers that took the First Steps in-service training; “Knowing Math” will refer to the group of teachers that participated in the Knowing Mathematics in-service training; and “Control” will refer to teachers that did not receive any training. The same group designations are used for students. Although there were some teachers who took both the Prime in-service training and the Knowing Mathematics in-service there were insufficient numbers to make a fifth group. As a result, the 4 teachers that took both Prime and Knowing Mathematics in-service training sessions were folded into the Knowing Math group because the students they reported on were from the Knowing Math classes.
Students

Information was collected on 1,558 students. Approximately 60% of the students were in grade 7 and 40% were in grade 8. There were slightly more males (56%) than females (44%). Teachers indicated that approximately 14% of the students had an Individual Education Plan (IEP) in mathematics. This number did not include a further 2% of students who had an IEP for giftedness in mathematics. These students’ results were folded into the results for the regular student population. A total of 2% of students were identified as English as Second Language (ESL) students. The small number of ESL students precluded separate analyses.
Instruments

Teachers
Teachers completed three questionnaires at the initial meeting and prior to the in-service session beginning. The first questionnaire collected general background information, such as, number of years teaching at the intermediate level and involvement in professional development opportunities (see Appendix 3). The second instrument collected information about teachers’ attitudes and general beliefs about teaching mathematics (see Appendix 4).

Teachers also completed the Content Knowledge for Teaching Mathematics (CKT-M) questionnaire early in December and again in June. The CKT-M is an instrument purported to examine the growth in mathematics knowledge which occurs as teachers gain experiences in classrooms, use new curriculum materials, and engage in mathematics-related opportunities to learn (Ball et. al., 2003). It is in a multiple-choice format that poses questions about problems typically arising in classrooms. For example, teachers may be asked how they respond to a student who gives an unusual solution to a question or to identify typical mistakes students make in mathematics.

The subscale on numbers and operations, Form A01 was administered and took approximately 30 minutes to complete. The total number correct was assigned a score derived from the application of Item Response Theory (IRT) and called an IRT score. Conversion tables provided an IRT equated scale score for each possible total raw score. The IRT scores are presented in standard deviation units. Differences between pre and post converted IRT scores give a measure of the effect size and were used to measure gains in content knowledge of mathematics (Phelps, 2005). The reliability of Form A01 was .72 -.80. The authors make the claim that the CKT-M can detect a moderate effect size (i.e., changes in teachers’ knowledge in the teaching of mathematics that result from professional development activities) in sample sizes greater than 60 (Hill, 2004).

Due to the nature of the tool, the authors requested that the items be kept secure. They have, however released a few items for discussion purposes (see Appendix 5).

In order to gain the trust of teachers participating in the project and in compliance with the authors’ contract for use of the CKT-M, teachers were informed both verbally and in writing that the information generated from the survey would not be used to evaluate individual teachers’ knowledge of mathematics (see Appendix 6). Instead, the responses were used to examine the types of activities that contributed to professional learning, and only group aggregate scores would be presented. Individual teacher responses were not shared with anyone outside the research group. All questionnaires were coded to ensure confidentiality and no teacher or school board was identified based on responses.
Students

To the greatest extent possible, measures taken from students were part of the regular assessment and evaluation process and were not conducted solely for research purposes. Parent/Guardians were sent an information letter detailing the project (see Appendix 7). Some measures of academic achievement were taken from the report card and included:

- literacy skills
- mathematics skills

Programming information about the student was taken from the report card and included:

- an IEP in mathematics
- a language designation of ESL

The report card was also used to record the following student characteristics:

- absenteeism
- gender

In January, and then again in June, students completed 2 diagnostic assessments from Prime (Note: The diagnostic assessments and scoring guide were used with permission from Nelson Publishers). The first diagnostic focused on the conceptual understanding of numbers (Numbers- Diagnostic F) (e.g., Would 703 be a big enough number to describe all the people living in a city? Explain your thinking), and the second diagnostic assessed students’ understanding of operations involving numbers (Operations- Diagnostic F) (e.g., Multiply: 0.32 x 2 = __ ).

Each diagnostic took approximately 15 minutes to complete and 1 minute to score. Teachers were given the option to score the diagnostics themselves or to return them to the research team for scoring. The majority of teachers in the Control group opted to have the research team score both the pre and post assessments and approximately 1/2 of the active group teachers opted to have the diagnostics scored for them, particularly those diagnostics written in June. The prescriptive scoring guide allowed for almost 100% agreement between markers on assigned scores. Students were assigned a number between 0 and 28 on each of the assessments that corresponded to a Phase of development on the developmental continuum between 1 and 5.

Note: Both Prime and First Steps have diagnostics designed to help inform teachers of students’ developmental stages. The decision to use the diagnostics from Prime was simply administrative and influenced by the availability of the assessments. A preliminary screening of same student scores on First Steps and Prime suggested that student performance did not change as a function of the diagnostic administered. However, further investigations would have to be done to establish a definitive relationship between the two diagnostic assessments.

Procedures

School boards used an internal procedure for recruiting teachers to the project. Each school board was responsible for distributing and collecting informed consent letters from teachers. Participating teachers distributed information letters to parents of students from the relevant classes. See Appendix 8 for a schedule of training sessions.
At the first training session, teachers were asked to complete the background questionnaire, the Teacher Attitude Survey and the CKT-M. Teachers in the Control group attended a half-day information session at which time they completed the same surveys. All teachers were invited to a wrap-up session at the end of June at which time they completed the Teacher Attitude Survey and the CKT-M again.

All teachers administered the diagnostic assessment and the student attitude questionnaire as soon as possible after the formal in-service training or the information session was completed. Teachers were given a student record sheet to record relevant student information throughout the project (see Appendix 9). The second round of diagnostic testing occurred primarily in June.

**Data Security**

Data collected from teachers and students were coded to ensure confidentiality and were stored in SPSS format (see attached Data Field layout in Appendix 10). Only the research team had access to codes. No teacher, student or school board was identified based on data collected and data will be presented in aggregate form only for this report and on all subsequent reports. All completed teacher surveys and student diagnostics were destroyed at the conclusion of the project.
RESULTS

Teachers
Background

Some background information was collected from all teachers. Table 1 details the average number of years teaching for each of the groups.

Table 1: Average Number of Years \( \pm \) Standard Deviation Across Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Yrs ( \pm ) S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>5.8 ( \pm ) 3.2</td>
</tr>
<tr>
<td>First Steps</td>
<td>11.2 ( \pm ) 8</td>
</tr>
<tr>
<td>Knowing Math</td>
<td>10.1 ( \pm ) 5</td>
</tr>
<tr>
<td>Control</td>
<td>13 ( \pm ) 8</td>
</tr>
</tbody>
</table>

Approximately 15% of the teachers had previously taught in the primary division, 45% had junior panel experience and 20% had taught at the secondary level.

The teachers also appeared to value professional development experiences and, with the exception of EQAO marking experience, had availed themselves of a variety of activities to stay current in their field. Teachers’ experiences also cut across disciplines as evidenced by the number of teachers that were involved in literacy initiatives. Similarly, only 31% of teachers indicated they belonged to a math association, suggesting the teachers were not necessarily math specialists. The only activity that distinguished between groups was the percentage of teachers taking a course for additional accreditation. More teachers in the in-service groups were taking courses for credit (47%) than in the control group (17%). Table 2 provides a description of the percentage of teachers that participated in various professional development activities.

Table 2: Professional Development Activities Engaged in within the Last 3 Years

<table>
<thead>
<tr>
<th>Professional Development</th>
<th>% agreeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff Meeting</td>
<td>94</td>
</tr>
<tr>
<td>Conferences</td>
<td>78</td>
</tr>
<tr>
<td>EQAO</td>
<td>7</td>
</tr>
<tr>
<td>Committees</td>
<td>86</td>
</tr>
<tr>
<td>Journals</td>
<td>73</td>
</tr>
<tr>
<td><strong>Courses</strong></td>
<td><strong>93</strong>*</td>
</tr>
<tr>
<td>Board math Initiatives</td>
<td>72</td>
</tr>
<tr>
<td>Board Literacy Initiatives</td>
<td>80</td>
</tr>
<tr>
<td>Other</td>
<td>80</td>
</tr>
<tr>
<td>Associations</td>
<td>31</td>
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* Differentiates teachers in the active group from the control group.
Attitudes

It appeared, in general, that all teachers espoused positive attitudes, and used progressive strategies in the teaching and learning of mathematics. The percentage of teachers expressing agreement, or strong agreement with statements that reflected positive attitudes and progressive behaviours are included in Table 3.

Table 3: Examples of Teacher Attitudes/Teaching Style

<table>
<thead>
<tr>
<th>Teaching Attitude/Style</th>
<th>% agreeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value diversity in solving problems</td>
<td>71</td>
</tr>
<tr>
<td>Present real life applications</td>
<td>50</td>
</tr>
<tr>
<td>Integrate concepts</td>
<td>52</td>
</tr>
<tr>
<td>Focus on student success</td>
<td>82</td>
</tr>
<tr>
<td>Communicate with parents</td>
<td>48</td>
</tr>
<tr>
<td>Communicate with other teachers</td>
<td>73</td>
</tr>
<tr>
<td>Focus on process as well as product</td>
<td>76</td>
</tr>
<tr>
<td>Use open-ended explorations</td>
<td>63</td>
</tr>
<tr>
<td>Use technology</td>
<td>73</td>
</tr>
</tbody>
</table>

Teachers also completed an attitude questionnaire at the end of the year. Teachers in both the Prime and Control group showed a slight increase in positive attitudes after participating in the project. The mean differences for all groups are displayed in Figure 2. Although statistically significant, the magnitude of the change was small, and thus probably not predictive of other changes.

Figure 2: Teacher Attitudes Over Time
Preliminary CKT-M Distribution

The initial distribution of IRT scores based on the first administration of the CKT-M is presented in **Figure 3**. There was some concern expressed initially, and in the literature (Hill, 2004) about ceiling effects for middle school teachers in using Form A01 as it was designed for, and piloted on, elementary school teachers (Note: The Forms for intermediate school teachers had not been released at the time of this study and thus were not available for use). Although the distribution is slightly negatively skewed, the distribution mirrors that of the author’s original sample of teachers. The mean IRT converted score of \(0.07 \pm 0.9\) standard deviations legitimize the use of this particular Form for this project.

**Content Knowledge for Teaching Mathematics: Pre-Inservice**

![Figure 3: Preliminary Distribution of CKT-M scores](image-url)
**Students**

**Background and Attitudes**

The only measure that students completed over and above regular classroom requirements was a questionnaire that collected information about their perceptions of mathematics (see Appendix 11). Survey data was entered for approximately 1,230 students. Students reported that although they liked math (65% said they liked math), and were good at math (70% said they were good at math), at least 14% said it was not their favourite subject. Approximately 21% of the students surveyed said that math was their least favourite subject and 18% of students reported they were not confident in doing any part of the mathematics curriculum. The majority of students (88%) felt that if you worked hard, you would get a good mark in math. The table below details the responses of students to the question, “Do you want a career that involves mathematics?”

**Table 4: Students and Career Aspirations that include Mathematics**

<table>
<thead>
<tr>
<th>Do you want a career that involves mathematics?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>21%</td>
</tr>
<tr>
<td>No</td>
<td>17%</td>
</tr>
<tr>
<td>Maybe</td>
<td>24%</td>
</tr>
<tr>
<td>Not sure what career I want.</td>
<td>24%</td>
</tr>
<tr>
<td>Not sure if the career I want involves Math.</td>
<td>16%</td>
</tr>
</tbody>
</table>
Preliminary Distribution on the Diagnostics

The performance of 1,558 students on the Numbers and Operations Diagnostics is graphically depicted in Figure 4. It appears that 47% of students were at less than Phase 4 in the conceptual understanding of Numbers and 60% were at less than Phase 4 in Operations. Stated another way, only 53% of the students were approaching a level appropriate to their grade expectations in Numbers and less than 40% of the students were approaching appropriate grade expectations in Operations as measured by these diagnostic assessments. When the data were broken down by grade level, there appeared to be about a 1 Phase difference between grade 7 and grade 8 students; although there was considerable overlap. Further discussion of this point is made in the analyses section.

Diagnostic Distributions: Time 1

![Figure 4: Initial Diagnostic Placements](image-url)
ANALYSES

Teacher Data

Content Knowledge for Teaching Mathematics (CKT-M)

A repeated measures analysis of variance (ANOVA) was conducted to determine whether CKT-M scores varied as a function of group membership and time. The type of in-service provided was the independent variable (i.e., Group Membership: Prime, First Steps, Knowing Math, Control) and the time of administering the CKT-M was the dependent, repeated measure (pre and post in-service training). The groups could not simply be collapsed into 2 groups (i.e., teachers who received in-service and the control group) because there was a significant difference in pre CKT-M scores between groups. The CKT-M score of the First Steps group was significantly lower than the other 3 groups.

The F statistic was significant for a Time effect, $F(1, 53) = 6.2$ and approached significance with $F(3, 53) = 2.5; p < .06$ for a Group Membership x Time effect. (Note: Although $p < .05$ is the usual standard for determining statistical significance, $p < .06$ was used in this case for reasons outlined below.) The pre and post mean growth rates for each group are depicted in Figure 5. Post hoc analyses of Group Membership means suggested that teachers in the Prime and First Steps groups showed the most growth in scores on the CKT-M as compared to either the Knowing Math or Control group.

Figure 5: Scores on the CKT-M as a Function of Group Membership
It will be recalled that growth scores, as measured by the CKT-M, can be reported in standard deviation units to measure effect size. In terms of IRT converted scores, it appears the *Prime* group experienced a .3 standard deviation in the growth of content knowledge for teaching mathematics while the *First Steps* group experienced a .2 standard deviation in the growth of knowledge as measured by the CKT-M. This is considered a moderate effect size and could probably have been increased significantly if the sample size had been larger. The likelihood of finding a significant difference between groups was significantly reduced (i.e., power = .6) by the smaller than recommended sample size and the short time frame for the project. That a difference between groups was almost statistically significant (p < .06 v p < .05) suggests that the effect of the professional development for teachers was very powerful. A larger sample size and a longer time frame for the conduct and development of professional learning communities appears warranted.

**Student Data**

The analyses of student data were complicated because of the number of variables under consideration. The pre and post scores on the Number and Operations diagnostics were the repeated measures, dependent variables; and Grade (i.e., 7, 8), Gender (i.e., male, female), IEP status (i.e., yes, no), and Group Membership (i.e., *Prime, First Steps, Knowing Math* and *Control*) were the independent variables (i.e., a multivariate 2 x 2 x 2 x 4 x 2 x 2 repeated measures design). Typically, all the variables are entered together and significant main effects and interactions are slowly broken down in order to qualify and interpret results. In order to make this process more comprehensible in the current study, significant main effects and interactions were noted for each of the independent variables and the influence of each main effect and/or significant interaction on the pre and post scores of the diagnostics was examined. The main effects are presented below followed by the variables that qualified the results.

**Student Performance on Diagnostic Measures**

A multivariate analysis of variance (MANOVA) was conducted on students’ diagnostic assessment scores. Group Membership was the independent variable (i.e., *Prime, First Steps, Knowing Math*, and *Control*) and actual scores obtained from both pre and post administration of the Numbers and Operations diagnostic assessments were the repeated, dependent variables.

A significant Group Membership by Time interaction was observed with F (6, 1,560) = 4.6; p < .01. Review of the subsequent univariate analyses revealed a significant interaction for Numbers with F (3, 780) = 6.6; p < .01 and a nearly significant interaction for Operations with F (3, 780) = 2.5; p < .06. Post hoc analyses on Group Membership suggested a statistically significant difference in Number scores for Knowing Mathematics and in Operations scores for both *Prime* and the *Knowing Mathematics* groups. **Figures 6a and 6b** display the pre and post means for students on the Numbers and Operations diagnostic assessments respectively.
Figure 6a: Mean Growth x Time on Numbers Diagnostic

Figure 6b: Mean Growth x Time on Operations Diagnostic

* Statistically significant main effect at the p < .06 level
** Statistically significant post hoc effect at the p < .05 level
Diagnostic Assessments of Students as a Function of Gender

Generally, boys are thought to perform better than girls on tests of mathematics ability although these perceptions are somewhat challenged by the results generated from the EQAO assessments conducted in Ontario. More girls than boys consistently score at levels 3 and 4 in tests of mathematical ability in both grades 3, 6 and females and males perform comparably in both academic and applied EQAO assessments of mathematics in grade 9. In order to determine if diagnostic scores varied as a function of Gender in the present study, a MANOVA was performed using both Gender and Group Membership as independent variables and pre and post scores on the Numbers and Operations diagnostic assessments as the dependent variables. There was a significant Gender main effect with F (6, 1604) = 2.7, p <.01. Univariate tests on the diagnostics revealed a non-significant interaction for the numbers diagnostic; F (1, 774) = 2.34; p < .1. and a significant interaction on the operations diagnostic F (1, 774) = 10.4; p < .01. Means are displayed in Figure 7. Females did consistently better than males on the operations diagnostic.

Figure 7: Diagnostic Scores as a function of Gender
Diagnostic Assessments of Students as a Function of Individual Education Plan (IEP) Status

A student with an IEP in mathematics has had her/his program modified from the regular program. Typically, students with an IEP do not do as well as students without an IEP on assessments of mathematical abilities (e.g., see EQAO results). In most cases, students with an IEP in mathematics would be considered an “at risk” group; at risk of failing to succeed in math. Indeed, *Knowing Mathematics*, was designed specifically for students experiencing significant difficulty in mathematics. Consequently, it was of some interest to determine whether or not students with an IEP performed significantly differently on the diagnostic assessments compared to students without an IEP.

A MANOVA was performed using both IEP status and Group Membership as independent variables and pre and post scores on the Numbers and Operations diagnostic assessments as the dependent variables. There was no significant interaction between IEP and Program; $F (6, 1,280) = 1.7; p < .13$. However, students with an IEP did perform significantly different than students without an IEP; $F (2, 639) = 18.0; p < .00$. The means score performance was significantly different on both the Number and Operations diagnostic. Figure 8 displays the results.

![Figure 8: Diagnostic Assessments of Students as a Function of IEP Status](image-url)
Diagnostic Assessments of Students as a Function of Grade

As noted in the introduction, the resources used as part of the professional development plan for teachers were initially designed for use with students in grades 1 to 6. A review of the materials led to the decision that the materials would be appropriate, in part because the targeted population for this project was students experiencing difficulty in mathematics. Indeed, the initial distribution of scores on the diagnostics suggested that using the developmental continuums would be appropriate because ceiling effects were not evident. In addition, there appeared to be a sufficient number of students functioning well below grade level; which was a pre-requisite for using the Knowing Mathematics program.

There was a significant Group Membership X Grade x Time effect $F (6, 1,552) = 2.4; p < .03$. Univariate analyses revealed that grade differences existed only for the Operations diagnostics; $F (3, 776) = 3.7; p < .01$. Grade 7 students in the Prime and Knowing Math groups had increased scores on the operations diagnostic as compared to students in either the First Steps or the Control groups.

In Grade 8, students in the Knowing Mathematics group actually show a slight decrease in scores. This latter finding is probably due to the small number of students who scored 0 or close to 0, on the final Operations assessment and should probably be viewed as an anomaly. **Figures 9a and 9b** graphically depict the means scores on each diagnostic as a function of Time and Group Membership on the Operations diagnostic.

**Operations Diagnostic**

**Grade x Group Membership x Time x Grade 7**

![Operations Diagnostic Graph](image)

Figure 9a: Grade 7 x Time x Group Membership
Operations Diagnostic
Grade x Group Membership x Time x Grade 8

9b: Grade 8 x Time x Group Membership
Correlations Between Diagnostic Measures, Report Card Marks, Attendance and Attitudes

Although correlations cannot denote causality it is often interesting to look at the relationship between variables to examine commonly held assumptions and to determine whether or not further investigations are warranted. Pearson product-moment correlations were generated between the variables listed below. Preliminary analyses suggested correlations did not change dramatically when run separately for males/females or by grade level. As a result, the correlations in Table 5 are based on aggregate data. Any differences in the magnitude of correlations based on Group Membership are discussed below.

Variable Abbreviations used in Table 5

- Numbers Diagnostic Pre-test Nu Pre
- Numbers Diagnostic Post-test Nu Post
- Operations Diagnostic Pre-test Op Pre
- Operations Diagnostic Post-test Op Post
- Report Card Math: Number Sense Term 1 MathT1
- Report Card Math: Number Sense Term 2 MathT2
- Report Card Math: Number Sense Term 3 MathT3
- Report Card Reading: Number Sense Term 1 ReadT1
- Report Card Reading: Number Sense Term 2 ReadT2
- Report Card Reading: Number Sense Term 3 ReadT3
- Days Absent: Term 1 AbsT1
- Days Absent: Term 2 AbsT2
- Days Absent: Term 3 AbsT3
- Attitude Towards Math: Pre-Test Preatt
- Attitude Towards Math: Post-Test Postatt

The resultant co-efficients are presented in Table 5. The large sample size increases the likelihood of finding statistically significant findings thus significant correlations less than .4 at p < .01 level, two tailed, have been suppressed. Non-significant correlations are indicated with ns.

Table 5: Correlations Between Diagnostics, Report Card Marks, Absenteeism, and Attitudes

<table>
<thead>
<tr>
<th></th>
<th>NuPre</th>
<th>NuPost</th>
<th>OpPre</th>
<th>OpPost</th>
<th>MathT1</th>
<th>MathT2</th>
<th>MathT3</th>
<th>ReadT1</th>
<th>ReadT3</th>
</tr>
</thead>
<tbody>
<tr>
<td>NuPre</td>
<td>1</td>
<td>.51</td>
<td>.66</td>
<td>.55</td>
<td>.48</td>
<td>.45</td>
<td>ns</td>
<td>.43</td>
<td>.48</td>
</tr>
<tr>
<td>NuPost</td>
<td></td>
<td>1</td>
<td>.50</td>
<td>.66</td>
<td>.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OpPre</td>
<td></td>
<td></td>
<td>1</td>
<td>.67</td>
<td>.53</td>
<td>.5</td>
<td>.42</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>OpPost</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>.5</td>
<td>.46</td>
<td>.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MathT1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>.76</td>
<td>.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MathT2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MathT3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>.58</td>
<td></td>
</tr>
<tr>
<td>ReadT1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ReadT3</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
The relationship between scores on the Number and Operations diagnostics is relatively strong (i.e., $r = .66$). The relationship between the math marks on the report card and the diagnostics is only moderate for term 1 and 2 marks in Number Sense (i.e., $r = .4$ to .5) and weak for term 3 marks (i.e., $r = .1$ to .3). It should be noted that when the correlations were generated separately for each group, the correlation between Term 3 math marks and Post Number and Operations Diagnostics increased for the active groups but not for the Control group (i.e., Prime, $r = .4$; First Steps, $r = .4$; Knowing Math, $r = .6$; Control, $r = .2$). These findings suggest that teachers used the knowledge gained from the diagnostics/ professional development activities to help generate Term 3 math marks. Indeed, anecdotal notes from one teacher in the Knowing Mathematics group remarked that term 3 marks were based solely on the students’ performance in the Knowing Mathematics group. It was somewhat reassuring to note that the relationship between reading and the diagnostics scores was only moderate suggesting that the diagnostics are not overly influenced by a student’s ability to read (c.f. EQAO scores).

It was as interesting to note the lack of correlations between some variables, as it was to review the significant correlations. Absenteeism, for example, was not significantly correlated to any of the achievement measures. Similarly, only the first attitude measure was moderately related to the first term math mark. Term 2 and term 3 marks were not significantly correlated with the attitude scales. The relationship between attitudes and achievement is not clear and these data are not particularly helpful in deciphering that relationship.
GENERAL DISCUSSION

The results from this pilot research project, although promising, are just preliminary. More information on the use and implementation of developmental continuums needs to be gathered. However, at least three important findings were generated from study and should prove to be a useful starting points for future research.

- Professional development activities increased teachers’ knowledge about teaching mathematics as measured by the CKT-M
- Exploration of developmental continuums (open-ended approaches) coupled with the opportunity to discuss classroom practices in a professional learning community were more effective at increasing teachers’ knowledge when compared to in-service directed at learning how to deliver a prescriptive program. However, some form of professional development, presented in a learning community environment, was better than no professional development at all for increasing teachers’ knowledge of the teaching of mathematics
- Students with teachers that participated in professional learning communities had increased scores on some measures of mathematical abilities as compared to students whose teachers were not involved in professional learning communities.

To a lesser extent, other findings generated from this project offered some support for findings from other studies.

- Females outperformed males on some aspects of mathematical ability
- Students without an IEP did better than students with an IEP in mathematics regardless of the intervention offered.
- Students in both grade 7 and 8 show a wide distribution of performance on measures of mathematical ability

Some issues remain unclear.

- The relationship between attitudes (both teachers and students) to mathematical performance
- The relationship between various measures of mathematical ability, such as the report card marks and scores on the diagnostic assessments

Several process issues were highlighted and the lessons learned from this study should be applied in any future activity.

- Teachers must have opportunities to try, discuss and formulate new approaches to mathematics. Simply offering inservice training was not effective in changing teachers’ understanding and subsequently, students learning
- There appears to be a significant need to have lots of lead time in introducing an alternative approach to the teaching of mathematics. Additionally, the likelihood of successfully implementing new resources and teaching methods is increased when teachers can work collaboratively in small groups within a school.
This study did raise the need to conduct many follow-up activities including the following.

- Sustainability of students’ learning and teachers’ approach to teaching mathematics given in-service training
- Factors that increase the likelihood of teachers trying new approaches to teaching mathematics
- The impact of various teaching roles in using and implementing various resources
- How to best meet the needs of special groups of students
REFERENCES


APPENDICES

Appendix 1: Descriptions of Prime (Nelson Publishers); First Steps (Pearson Publishers); and Knowing Mathematics (Houghton Mifflin Publishers)

Appendix 2: Letter of Information to Senior Administration and Principals

Appendix 3: Teacher Background

Appendix 4: Teacher Attitudes

Appendix 5: Released Items from CKT-M

Appendix 6: Consent Form

Appendix 7: Parent Information Letter

Appendix 8: In-Service Training Sessions

Appendix 9: Student Record Data Collection Sheet

Appendix 10: Data Layout

Appendix 11: Student Attitudes
Appendix 1

Description of

- Prime
- First Steps
- Knowing Mathematics
Descriptions of Resources

Each of these descriptions is taken from promotional material provided by the publishers as well as the actual documents associated with each resource. Teacher in-service must accompany the use of any of the materials listed below.

First Steps in Mathematics®: Published by Pearson Education Canada

First Steps in Mathematics® is based on extensive research that began with the revelation that there were gaps in the field of knowledge about how students learned mathematics. In response, Dr. S. Willis led a team of researchers to better understand how students’ mathematical knowledge developed. Intensive and extensive interviews with students identified characteristic phases in the development of student’s thinking about major mathematical concepts. Dr. Willis identified 4 major strands of mathematics; Number/Algebra, Measurement, Space/Geometry, and Chance and Data.

For each identified strand, First Steps in Mathematics® provides a detailed diagnostic map replete with 6 phases of development. The diagnostic maps describe the characteristic phases in the development of a student’s thinking about the major concept for each set of learning outcomes. The diagnostic maps enable teachers to understand why students can do some things and not others, why some students may be experiencing difficulties, indicate the misconceptions that some students may have, and finally, help teachers generate an appropriate instructional response to students’ responses. The six phases of development correspond roughly to ages 3-5 to 11-13.

First Steps in Mathematics® is organized around a series of statements described as Key Understandings. These statements describe the skills and knowledge necessary for students to have in order to achieve the outcome. Pointers are provided to guide teachers in their assessment and evaluation of student learning. In recognizing that students of various ages can be at the same developmental stage in mathematical thinking, activities aligned to the Key Understandings are provided for three broad age groups.

PRIME: Thomson Publishers

PRIME is a research-based, Canadian resource designed around the phases of development that children travel through while learning key concepts and skills in mathematics. Thousands of samples of student work were used to identify five phases of mathematical development in five areas of mathematics; Number and Operation, Patterns and Algebra, Geometry, Measurement, and Data Management and Probability. Research also identified key assessment items to assist teachers in determining student placement and growth on the developmental continuum.

The developmental continuum for each strand is structured according to the key concepts and skills associated with that strand. The Diagnostic Tools booklet provides tools to confirm a child’s placement on the developmental continuum. Used in concert with the guides, the developmental maps provide a description of each phase using behavioural indicators, representation of student responses and strategies to prepare students for the next phase.
Teachers’ professional development is designed to increase the teacher’s knowledge and understanding of key mathematical concepts, skills and processes. The focus is on understanding individual students’ responses and developing appropriate instructional responses.

**Knowing Mathematics: Houghton Mifflin**

Knowing Mathematics was written by Dr. Liping Ma and educational researcher, Dr. Cathy Kesel. It is based on many years of research and combines best practice from both Asia and the United States. Knowing Mathematics is designed as an intervention strategy for students in grades 4 to 6 who are two or more years behind grade level in mathematics. Using a small group approach, students participate in learning mathematics in a different way over a 12 to 14 week period.

The program is based on three core units: addition and subtraction, multiplication and division, and place value. The lessons use a predictable structure that emphasizes visual models, vocabulary, interactive practice, reasoning, and review. The Teacher’s Guide is scripted with detailed instructions for guiding and pacing student learning.
Appendix 2

Letter of Information to Senior Administration and Principals
Dear Colleague,

The Ministry of Education recently released a document prepared by an expert panel that details a comprehensive strategy for improving the performance of all students in mathematics. The document, Leading Math Success, recommended that “...school boards work with the Ministry of Education to develop regional networks of expertise to support the professional learning of teachers of mathematics- including special education teachers” (p. 59). In addition, the Ministry is particularly concerned about students who do not do well in mathematics. To address the needs of struggling learners, the expert panel recommended that the Ministry work with partners to “…deliver research-based intervention programs for students at risk in mathematics” (p.34).

The Ottawa-Carleton Catholic School Board supported by the Ministry of Education and in partnership with the Ottawa District School Board and Upper Canada School Board, has prepared a series of workshops to aid in the delivery of the mathematics curriculum for students in grades 7 and 8. This pilot project will be taking place in approximately 70 classrooms between December and June of this school year.

The purpose of the professional development is to help teachers increase their understanding of how students learn mathematics and to offer teachers the opportunity of expanding their repertoires of strategies for helping students at risk in mathematics to learn. Teachers will be invited to spend time with experts learning about developmental continuums for mathematics; analogous to those developed for literacy. Some teachers will also be supported through a professional learning community to explore new methods and materials for use in the classroom.
The first funded portion of the project will take place between December 2004, and June 2005. Teachers that do not have the opportunity this year to participate in the actual training due to size and training limitations can still participate by serving as controls. The opportunity to participate in the professional development activity may be offered to those same teachers during the 2005-2006 school year.

Teachers who have volunteered for this project may be asked to use specific teaching tools and/or assessment tools in their classroom. They will also be asked to complete a questionnaire designed to collect background information as well as a tool designed to evaluate how effective the professional development experience was in terms of increasing teachers’ knowledge about how children learn mathematics. The Ministry of Education would also like to capture the learning experience of teachers as they go through the professional development activities on videotape. The intention is to develop a training video that would be useful to other professional development leaders across the province.

All costs related to the project, including release time, facilitator and facilities costs as well as classroom materials related to the project, will be covered through the PRISM budget, supported by the MOE and managed by the Ottawa-Carleton Catholic School Board.

Parents will receive an information letter about the project and teachers will be asked to sign a consent letter prior to participating. It is expected that a report on the results of the experiences will be released in November, 2005.

Thank you in advance for your interest in this project. Should you have any questions or concerns about the project, please do not hesitate to contact the individuals at the numbers listed below.

Contacts

Thomas Steinke                                Myrna Ingalls
PRISM Chairperson                            Education Officer
Ottawa-Carleton Catholic School Board        Ministry of Education
(613) 226-3419                               (416) 325 – 2858
Thomas_Steinke@ocdsb.on.ca                   Myrna_Ingalls@edu.gov.on.ca
Appendix 3

Teacher Background
Teacher Questionnaire – Background Information

Name: __________________________________________
School: _______________________________________
Board: ________________________________________

Please answer the following questions:

1. How many years, including this one, have you taught …
   - …. at the Primary Level? ________
   - …. at the Junior Level? ________
   - …. at the Intermediate Level? ________
   - …. at the Secondary Level? ________

2. Please indicate any of the professional development activities you have engaged in during the last 3 years:

<table>
<thead>
<tr>
<th>Professional development activities during staff meetings</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conferences</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>EQAO marking or secondment</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>School level special committee (e.g., remediation projects, literacy initiatives, school improvement teams etc.)</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Reading subject specific journals</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Courses for accreditation</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Board level math workshops</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Board level literacy workshops</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Other Board level PD</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

3. Do you belong to any Mathematics associations? ________

THANK YOU
Appendix 4

Teacher Attitudes
Programming, Remediation, Intervention for Students in Mathematics - PRISM

**Teacher Questionnaire – Attitudinal**

Teacher: ________________________________

School: ________________________________

Board: _________________________________

Circle the extent to which you agree with each statement, according to the A to F scale below.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Mildly Disagree</th>
<th>Mildly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>

1. I assign math problems that can be solved in different ways.

2. I regularly have all my students work through real-life math problems that are of interest to them.

3. When students solve the same problem using different strategies, I have then share their solutions with their peers.

4. I often integrate multiple strands of mathematics within a single unit.

5. I often learn from my students during math because they come up with ingenious ways of solving problems that I have never thought of.

6. It’s often not productive for students to work together during math.

7. Every student should feel that mathematics is something he or she can do.

8. I plan for and integrate a variety of assessment strategies into most math activities and tasks.
9. I communicate with my students’ parents about student achievement on a regular basis as well as about the math program.

10. I encourage students to use manipulatives to communicate their mathematical ideas to me and to other students.

11. When students are working on problems, I put more emphasis on getting the correct answer rather than on the process followed.

12. Creating rubrics is a worthwhile exercise, particularly when I work with my colleagues.

13. It is just as important for students to learn probability as it is to learn multiplication.

14. I don’t necessarily answer students’ math questions, but rather ask questions to get them thinking and let them puzzle things out for themselves.

15. I don’t assign many open-ended tasks or explorations because I feel unprepared for unpredictable results and new concepts that might arise.

16. I like my students to master basic operations more than they can tackle complex problems.

17. I teach students how to communicate their math ideas.

18. Using technology distracts students from learning basic skills.

19. When communicating with parents and students about student performance, I tend to focus on students weaknesses instead of strengths.

20. I often remind my students that a lot of math may not be fun or interesting but it’s important to learn it anyway.
Appendix 5

Released Items from CKT-M
(Not included in this package)
Appendix 6

Consent Form
Leading Math Success: Professional Development Project: PRISM

CONSENT FORM

Teacher Name: ______________________________________________

School Name: ______________________________________________

School Board: ______________________________________________

Dear Teacher and Colleague,

The Ministry of Education and Training is supporting a professional development activity in three school boards in eastern Ontario. The purpose of the professional development is to help teachers increase their understanding of how students learn mathematics and to offer teachers the opportunity of expanding their repertoires of strategies for helping students at risk in mathematics to learn. Teachers will be invited to spend time with experts learning about developmental continuums for mathematics; analogous to those developed for literacy. Some teachers will also be supported through a professional learning community to explore new methods and materials for use in the classroom.

The first funded portion of the project will take place between December 2004, and June 2005. Teachers that do not have the opportunity this year to participate in the actual training due to size and training limitations can still participate by serving as a comparison group. The opportunity to participate in the professional development activity may be offered to those same teachers during the 2005-2006 school year.

In order to help us determine the effectiveness of the professional learning experience, teachers will be asked to complete an instrument that attempts to look at the knowledge growth which occurs as teacher’s gain experiences in classrooms, use new curriculum materials, and engage in mathematics-related opportunities to learn. The first part of the survey asks some background demographic questions. The second part of the instrument asks teachers to answer questions that represent problems that typically arise in classroom, for example, unusual student solutions to questions or typical student mistakes with material. The information generated from the survey will not be used to evaluate teachers’ knowledge of mathematics, or students’ knowledge of mathematics. Instead, we
will be examining responses from groups of teachers in the hopes of learning what types of activities contribute to professional learning. Individual teacher responses will not be shared with anyone outside the research group. All questionnaires will be coded to ensure confidentiality and no teacher or school board will be identified based on responses.

The Ministry of Education would also like to capture the learning experience of teachers as they go through the professional development activities on videotape. The intention is to develop a training video that would be useful to other professional development leaders across the province. As a result, we are requesting permission to videotape you as a participant in the workshops.

If you have any questions about this project please do not hesitate to contact either of the individuals listed below.

Contacts

Thomas Steinke
PRISM Chairperson
Ottawa-Carleton Catholic School Board
224-2222 ext. 2240
Thomas_Steinke@occdsb.on.ca

Marilyn Kasian Ph. D
Research Advisor to PRISM
Ottawa-Carleton Catholic School Board
224-2222 ext. 2240
Marilyn_Kasian@occdsb.on.ca

I agree to participate in the PRISM project. This consent includes agreement to being videotaped if I am a participant in the training sessions and allowing the release of the material produced through videotaping for educational purposes.

__________________________________________  _______________________________________
Signature                                      Date
Appendix 7

Parent Information Letter
February 2, 2005
Dear Parent/Guardian,

We would like to inform you about an exciting project that will be taking place in your child’s classroom between December and June of this school year. The Ministry of Education recently released a document prepared by an expert panel that details a comprehensive strategy for improving the performance of all students in mathematics. The document, *Leading Math Success*, recommended that “…school boards work with the Ministry of Education to develop regional networks of expertise to support the professional learning of teachers of mathematics— including special education teachers” (p. 59). In addition, the Ministry is particularly concerned about students who do not do well in mathematics. To address the needs of struggling learners, the expert panel recommended that the Ministry work with partners to “…deliver research-based intervention programs for students at risk in mathematics” (p. 34).

The Ottawa-Carleton Catholic School Board supported by the Ministry of Education and in partnership with the Ottawa District School Board and Upper Canada School Board, has prepared a series of workshops to aid in the delivery of the mathematics curriculum for students in grades 7 and 8. Teachers who have volunteered for this project may be asked to use specific teaching strategies and/or assessment tools in their classroom. Information will be collected from both teachers and students in order to help us determine the effectiveness of the professional development provided to teachers.

From students, we want to measure how well they are doing in the areas of mathematics that we have targeted (i.e., number sense, decimals and fractions). With the exception of a short attitudinal survey about mathematics, all information generated is part of regular classroom practice. Information will be gathered from the report card as well as how well students did on particular in-class assessments. It should be noted that no student, school or Board would be identified by name. We will contact you again with a request for consent should we require any other detailed information from or about your child.

If you have any questions about this project please contact either of the people listed below. We thank you in advance for your support in helping to improve the education of our children.

**Contacts**

Marilyn Kasian Ph. D  
Research Advisor to PRISM  
Ottawa-Carleton Catholic School Board  
224-2222 ext. 2240  
marilyn_kasian@occdsb.on.ca

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Ministry of Education  
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Appendix 8

In-Service Training Sessions
SCHEDULE OF TRAINING SESSIONS

1. DEVELOPMENTAL CONTINUUM PREVIEW SESSIONS

   First Steps in Mathematics (FSiM) Preview Session
   Bill Nimigon, Terry Nikkel and Jamie Fraser FSiM presentation to Steering Committee

   PRIME Preview Session
   Rob Greenaway from Nelson Thomson Learning PRISM presentation

2. DEVELOPMENTAL CONTINUUM TRAINING SESSIONS

   PRISM Training Session for 30 teachers:
   - November 25, 2004
   - December 14, 2004

   (location in Ottawa to be determined)

3. PRISM GSP CONFERENCE

   Location and presenters to follow.

4. INTERVENTION PROGRAM TRAINING SESSIONS

   Knowing Math Intervention Program:

   PRISM Criteria Subcommittee meeting December 7, 2004, 5:00 – 8:00 p.m.
Appendix 9

Student Record Data Collection Sheet
Appendix 10

SPSS Data Layout
(Not included in this package)
Appendix 11

Student Attitudes
ATTITUDE QUESTIONNAIRE

LEADING MATH SUCCESS – PRISM
PROGRAMMING REMEDIATION AND INTERVENTION FOR STUDENTS IN MATHEMATICS

Student Name: ____________________________ Grade: _______ Date: _________________________
School: ____________________________ Teacher: _____________________________________

Please read each question and circle the best answer:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Do you like Mathematics?</td>
<td>Yes</td>
</tr>
<tr>
<td>2.</td>
<td>Is Math your favourite subject in school?</td>
<td>Yes</td>
</tr>
<tr>
<td>3.</td>
<td>Is Math your least favourite subject in school?</td>
<td>Yes</td>
</tr>
<tr>
<td>4.</td>
<td>Are you good at Mathematics?</td>
<td>Yes</td>
</tr>
<tr>
<td>5.</td>
<td>When you work hard at Math in school, do you receive a good mark?</td>
<td>Yes</td>
</tr>
<tr>
<td>6.</td>
<td>Do you use a calculator to learn Mathematics in school?</td>
<td>Never</td>
</tr>
<tr>
<td>7.</td>
<td>Do you use a computer to learn Mathematics in school?</td>
<td>Never</td>
</tr>
<tr>
<td>8.</td>
<td>Do you ask for help to complete your Math homework?</td>
<td>Never</td>
</tr>
<tr>
<td>9.</td>
<td>Do you use Math to solve problems outside of school?</td>
<td>Never</td>
</tr>
<tr>
<td>10.</td>
<td>Do you want a career that involves Math? (check the appropriate box)</td>
<td>Yes</td>
</tr>
<tr>
<td>11.</td>
<td>What part(s) of Math can you do with confidence? (check all that apply)</td>
<td>Problem Solving</td>
</tr>
<tr>
<td>12.</td>
<td>What part(s) of Math do you have difficulty with? (check all that apply)</td>
<td>Problem Solving</td>
</tr>
</tbody>
</table>

Thank you for completing this questionnaire.