Assessing Public Opinion and Awareness of Ohio's Education System in Mathematics and Science
Final Report

Prepared for:

Ohio Mathematics and Science Coalition

College of Education
Division of Teacher Education

In collaboration with
Evaluation Services Center
University of Cincinnati

March, 2001

Assessing Public Opinion and Awareness of Ohio's Education System in Mathematics and Science

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Assessing Public Opinion and Awareness of Ohio's Education System in Mathematics and Science

Executive Summary

The purpose of this project was to assess levels of awareness and opinions of the general public with respect to the teaching and learning of mathematics and science in Ohio public schools. The Ohio Mathematics and Science Coalition (OMSC), established in 1995, has the primary focus of advocating for systemic and sustainable improvement of Pre-K to 16 mathematics and science education. The OMSC has written by-laws, defined goals and activities for its Action Teams, developed brochures for key stakeholders, developed its own web site, and continues to establish and strengthen relationships with educators, industry, government, and the public sector.

The OMSC, in conjunction with the Division of Teacher Education and the Evaluation Services Center of the College of Education at the University of Cincinnati, formed the OMSC Vision Document Development Team to design and administer a public awareness survey to assist in accomplishing its purposes. The survey was designed to substantiate the current "state of the state" related to public perceptions of mathematics and science education in Ohio and to substantiate subsequent recommendations with research-based results and evidence of the levels of stakeholder support for continuous improvement. Data from this survey will be used to inform the development of the OMSC Vision Document.

In light of growing concern in Ohio about the quality of public education in general, and the teaching of mathematics and science in particular, the OMSC Vision Document Development Team identified the following key questions that must be addressed as part of any reform efforts:

- What are the key components of a world-class science and mathematics education?
- What must be done to assist schools in becoming units of change for implementing improvements in performance?
- How can a world-class education be made available to every student in Ohio?
- How can Ohio promote professional development for all teachers?

This study was designed to investigate the following major questions:

1. What do residents of Ohio believe are the most critical elements of a quality education in mathematics and science?

2. What mathematics and science courses and skills do Ohio residents believe all students should master?

3. What possible changes in the delivery of mathematics and science education are valued by residents of Ohio?

4. How likely are Ohio residents to support the costs associated with changes in the delivery of mathematics and science education in Ohio public schools?

Summary of Results

Elements of a Quality Mathematics and Science Education

Respondents believed that:

- Mathematics and science should help students make sense of the world around them (94.1%)

- Mathematics has value in the workplace and the economy (92.3%) and will improve students' job opportunities (94.4%)

- Science has value in the workplace and the economy (81.7%) and will improve students' job opportunities (85.2%)

- Basic skills needed in mathematics and science have changed over the past 30 years (67.6% mathematics, 73.1% science)

- Elementary teachers should have specialized training in mathematics and science (86.3%)

- All teachers should be tested periodically to determine their proficiency in mathematics and science (90.9%)

The majority of respondents (84.9%) believed that Ohio's mathematics and science proficiency tests should be comparable to other state and national tests. However, only 49.2% believed that the proficiency tests were a fair measure of student learning.

Courses and Skills Students Should Master

Respondents were asked to identify the mathematics and science courses and skills they believed should be required for graduation from high school:

- Mathematics courses and skills were more likely to be identified than were science courses

- Courses and skills that were more basic and applicable to daily living were more likely to be identified, including: basic arithmetic, biology, algebra, reasoning and problem-solving, knowing how to communicate and explain mathematics, and using calculators and computers to do mathematics

- Courses and skills that were more theoretical and less applicable to daily living were least likely to be identified, including: chemistry, probability and statistics, physics, knowing how to communicate and explain science, and completing a scientific research project

Proposed Changes in the Delivery of Mathematics and Science Education

- More than 90% of respondents believed that the following strategies were important to implement in mathematics and science education: professional development for current teachers (97.1%), providing current technology in classrooms (95.3%), improving school to work linkages (95.1%), hiring more teachers (94.3%), and measuring learning better (93.8%)

Willingness to Support the Costs of Improvement

- Few respondents (4.8%) would prefer to spend less in tax money to improve mathematics and science education than they currently spend

- Respondents were closely divided between those who would be willing to spend more (44.6%) and those who would prefer to spend the same (47.2%) to improve mathematics and science education

- Parents of public (51.7%) and private (53.3%) school children were willing to spend more to improve science and mathematics education than to spend the same or less

- Parents of parochial school children (53.7%) would prefer to spend the same to improve science and mathematics education than to spend more

- Respondents support the development of standards for teaching and learning in mathematics and science (92.6%)

- Respondents are fairly evenly divided as to whether standards should be set at the local (29.6%), state (36.1%), or national (30.6%) levels

Demographics of Respondents

Respondents were evenly distributed across the 12 Ohio regional professional development zones. The following characteristics were noted:

- Of the total sample, 59.7% were male and 40.3% were female
- The largest group of respondents (46.8%) was between the ages of 36 and 55; 26.1% of respondents were age 56 or over; 17.7% were between the ages of 26 and 35; and 8.7% were under age 25
- Most respondents (87.4%) lived in households of one to four people with 32.8% living in two-person households, 19.8% in four-person households, 17.9% in three-person households, and 16.9% in one-person households
- Over one-fifth of respondents (22.1%) reported incomes greater than $60,000 per year; 18.5% reported incomes of $25,000-39,999
- The two most commonly reported occupational categories were professional (22.8%) and retired (18.3%); sales/service and trade occupations were reported by approximately 11% of respondents; white-collar occupations were reported by another 10.2% of respondents
- Of respondents reporting incomes of $50,000 or more, 53.9% identified their occupations as professional
- Of the total sample, 88.9% described themselves as Caucasian, 5.0% as African American, 0.4% as Asian or Pacific Islander, 1.1% as Hispanic, 1.1% as Native American, and 3.8% as other or no answer
- Educational attainment of respondents was fairly evenly distributed among high school graduates (34.4%), some college or technical training (29.1%), or four-year college degrees (30%). Of those with a four-year college degree, about half had also completed graduate school coursework or a graduate degree
- Parents of school-aged children made up 36.3% of the sample
- The majority of respondents (78%) have voted at least once in the past four years
- There is a positive correlation between age and participation in voting and between income and participation in voting

Conclusions

Overall, respondents believe in the practical value of mathematics and science education. This is evident in their expressed support for changes in the delivery of mathematics and science education, including increased teacher training and hiring, improved classroom technology, and increased linkages between schools and the workplace.

Respondents believe that a quality education in mathematics and science will result in improved job opportunities for students and allow them to contribute to the workplace and the economy. Respondents believe that mathematics and science must help students make sense of the world around them. To that end, respondents identified courses and skills, particularly in mathematics, that are more commonly associated with practical application than with theory as essential for graduation from high school.

Specialized training for teachers in mathematics and science is also an important element of a quality education in mathematics and science. Respondents believe that training and hiring of new teachers should also be accompanied by professional development opportunities for current teachers to enable them to improve their skills in mathematics and science. Accountability is important, however, and respondents also believe that teachers should be periodically tested with respect to their skills and proficiency in mathematics and science.

Accountability for students was a different matter. While most respondents believe that it is important to measure learning better, a large number did not consider state proficiency tests in mathematics and science a fair measure of student learning. This suggests that alternative means for measuring student learning in mathematics and science be explored and developed for use by schools.

Support for changes in the delivery of mathematics and science education is more problematic. While few respondents indicated a preference for spending fewer tax dollars, the remainder were almost evenly divided between preferring to spend at the same level and willing to spend more. This suggests that additional tax levies to support improvements may not be an effective vehicle for funding changes. Thus, while respondents value and recognize the importance of a quality education in mathematics and science, they are not yet ready to fully support additional costs to implement necessary changes in the delivery of mathematics and science education.

Assessing Public Opinion and Awareness of Ohio's Education System in Mathematics and Science

Introduction

The purpose of this project was to assess levels of awareness and opinions of the general public with respect to the teaching and learning of mathematics and science in Ohio public schools. The Ohio Mathematics and Science Coalition (OMSC), established in 1995, has the primary focus of advocating for systemic and sustainable improvement of Pre-K to 16 mathematics and science education. The OMSC has written by-laws, defined goals and activities for its Action Teams, developed brochures for key stakeholders, developed its own web site, and continues to establish and strengthen relationships with educators, industry, government, and the public sector.

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In light of growing concern in Ohio about the quality of public education in general, and the teaching of mathematics and science in particular, the OMSC Vision Document Development Team identified the following key questions that must be addressed as part of any reform efforts:

- What are the key components of a world-class science and mathematics education?
- What must be done to assist schools in becoming units of change for implementing improvements in performance?
- How can a world-class education be made available to every student in Ohio?
- How can Ohio promote professional development for all teachers?

Recognizing that major change efforts within the public educational system of this state will directly impact public attitudes and perceptions, it was deemed necessary to first identify public awareness, knowledge, and beliefs with respect to key elements of mathematics and science education in the public schools.

The OMSC Vision Document Development Team conducted this project in three stages. During the initial stage, team members identified the information to be determined from the survey and developed a preliminary version of the instrument. During the second stage, the survey instrument was piloted. The results of the pilot activities were used to further refine the survey. During the final stage, the survey was administered statewide and the results were analyzed. This report details those findings and presents conclusions and recommendations based on those findings.

Research Questions

This study was designed to investigate the following major questions:

1. What do residents of Ohio believe are the most critical elements of a quality education in mathematics and science?

2. What mathematics and science courses and skills do Ohio residents believe all students should master?

3. What possible changes in the delivery of mathematics and science education are valued by residents of Ohio?

4. How likely are Ohio residents to support the costs associated with changes in the delivery of mathematics and science education in Ohio public schools?

Research Procedures

This project utilized a scaled survey administered by telephone to residents across the state of Ohio during the winter of 2000. Respondents were asked to indicate their agreement with a series of questions related to mathematics and science. Respondents were also asked several demographic questions.

Participants

Participants were contacted by phone during January and February of 2000. Adult residents of Ohio were selected at random and coded by their county of residence. A stratified sampling plan was used to assure even distribution across the 12 Regional Professional Development Center regions. A total of 1527 adults participated in the survey (see Table 1).

Instrument

Data were collected through the use of a structured survey with scaled responses. Questions addressed the following areas: (a) beliefs about teaching preparation and

practices; (b) beliefs about necessary coursework; (c) beliefs about possible changes in service delivery; and (d) demographic information.

Table 1. Distribution of participants by region

Region	Counties in Region	n	%
1	Franklin, Delaware, Licking, Union, Madison, and Pickaway	125	8.2
2	Williams, Fulton, Lucas, Defiance, Henry, Wood, Ottawa, Sandusky, and Erie	125	8.2
3	Paulding, Putnam, Hancock, Hardin, Allen, Auglaize, Mercer, and Van Wert	129	8.4
4	Darke, Preble, Montgomery, Greene, Clark, Champaign, Logan, Shelby, and Miami	125	8.2
5	Butler, Hamilton, Clermont, Brown, Highland, Fayette, Clinton, and Warren	129	8.4
6	Seneca, Huron, Wyandot, Crawford, Richland, Marion, Morrow, and Knox	131	8.6
7	Ross, Pike, Jackson, Gallia, Lawrence, Scioto, and Adams	128	8.4
8	Lake, Geauga, Cuyahoga, and Lorain	126	8.3
9	Medina, Summit, Portage, Stark, Wayne, Ashland, and Holmes	126	8.3
10	Coshocton, Tascarawas, Carroll, Harrison, Jefferson, Belmont, Guernsey, Noble, and Muskingum	125	8.2
11	Fairfield, Perry, Morgan, Washington, Monroe, Hocking, Athens, Vinton, and Meigs	125	8.2
12	Trumbull, Mahoning, and Columbiana	133	8.7
	Total	**1527**	**100.0**

Pilot instrument. The OMSC Vision Document Development Team conferred several times during the development of the survey. The team first identified the basic premises of the survey: (a) what needed to be learned; (b) target audiences for the results; (c) the population that should be surveyed; and (d) uses for the results of the survey (see Appendix A). The following topics were identified as key areas around which to build questions: (a) curriculum and instruction; (b) accountability; (c) standards; (d) teacher quality; (e) resource allocation; (f) assessment; (g) strategies to improve performance; (h) public support; and (i) technology. Draft questions were developed and reviewed by the team prior to inclusion in the survey instrument.

An early assessment of survey items and length was conducted in late November, 1999. Six respondents were chosen at random from the Greater Cincinnati telephone book. The questionnaire consisted of 56 questions. Due to the lack of necessary transitional statements between sections of questions, the interviews did not flow smoothly. It was also obvious that that some items were being interpreted much differently than was intended. As an example, a question asking about the need to study "biology or how living organisms continue and change across generations" elicited questions and comments about evolution instead of participants' beliefs with respect to whether or not this course should be required for graduation from high school. On average, this initial survey took 18 minutes to complete.

The Visioning Team used these results and conducted a consensual process of question elimination and refinement. They also added clarifying and transitional statements to the survey. A second pilot version of the survey was tested in early December, 1999. A key concern with this version was its length. Of the 23 survey interviews conducted, all but 5 took 15 minutes or more to complete. Four of the interviews required 20 minutes to complete. Due to budget and interview completion concerns, it was essential that the final instrument take no more than 10 minutes to complete.

Two other key issues that arose during the course of piloting the survey pertained to participant comprehension of the survey instrument and to training of interviewers. It was found that some of the questions were too complex and technical for the general public to understand easily. Educational and technical jargon (e.g. trigonometry, estimation, probability, photosynthesis) needed to be eliminated. Questions needed to be written in a manner that was clear, concise, and easily understood by participants. Key information that needed to be repeated during the survey was identified, and questions were edited accordingly.

The second issue concerned training and monitoring of interviewers. During the pilot, some of the instructions were misunderstood by interviewers. Two groups of questions were designed so that half of each group addressed mathematics and the other half science. In order to control for order effects, interviewers were instructed to alternate the order in which they asked these groups of questions (e.g. mathematics questions followed by science questions alternating with science questions followed by mathematics questions). What actually occurred was that some respondents were asked only the mathematics or the science questions instead of being asked both mathematics and science questions. Additionally, some respondents commented that they had a hard time hearing the difference between questions when the interviewer shifted from asking about mathematics to asking about science. Adjustments were made to the script of the final survey instrument to address these two issues, and interviewers were monitored during the final survey to assure consistency and compliance.

Final instrument. The pilot instrument was refined in order to address the issues of timing, comprehension, and interviewer error discussed above. The instrument was also refined to assure more even distribution of topics across the previously identified areas of inquiry. The final instrument consisted of a total of 49 questions of which 11 were demographic and 38 were topical (see Appendix B). Three types of scaled responses were possible depending on the question. Some required only a yes or no response. Some required respondents to rank their degree of agreement with a set of statements on a scale of 1 to 5 (1=disagree a lot; 3=neither agree or disagree; 5=agree a lot). Others required respondents to rank each statement according to their belief in its importance (1=not at all important; 2=somewhat important; 3=very important). Demographic questions required respondents to pick from a list of possible choices.

Data Collection Procedures

Data were collected through phone interviews during the months of January and February, 2000. Interviewers were trained and rehearsed so that they could administer the survey in 10 minutes or less. Project personnel monitored the interviews to assure consistency, clarity of procedures, and adherence to the ordering of the two specific groups of questions.

The survey was administered by a market research firm using a computer assisted telephone interviewing (CATI) system. Interviewers read from a script displayed on each computer monitor and entered respondents' answers directly into the database. The market research firm accessed the State of Ohio school improvement website (www.ODE.state.oh.us) to obtain information regarding region composition by county. Each region contained from 3 to 11 contiguous counties. Each of Ohio's 88 counties was assigned to one of the regions with the exception of Gallia, which was shared in two regions. For purposes of this study, the decision was made to apply Gallia solely to Region 7. Random Digit Dial (RDD) samples were produced by Survey Sampling, Inc. for each of these 12 sampling regions. With the RDD methodology, numbers within a sampling frame have a known and equal chance of being selected into a sample. The number of records selected from each county was proportionate to the number of estimated household listings in the sampling frame. In other words, the more populated counties in a given region have greater representation in each regional sample than less populated counties in the region. The sample was screened for non-working phone numbers, and known business numbers were excluded. Up to three attempts were placed for each number. Participants were selected at random by the computerized dialing system with a target quota of 100 completed interviews per region.

Demographics were monitored periodically to assure even distribution across gender. During the course of the survey, it became apparent that the bulk of the respondents were male. The original design of the survey called for interviewers to ask alternately for the male or female head of household aged 18 or over. It was discovered, however, that the script interviewers were using did not provide instructions to alternate gender when asking for the head of household. Instead, interviewers first requested the male head of household in all cases. If there was no male head of household present or

available, interviewers then requested the female head of household. As a result, the decision was made to collect data beyond the original quota of 100 completed interviews per region. For these additional calls, only the female head of household was requested to participate in order to obtain a relatively balanced distribution of male and female respondents. A total of 1527 interviews were completed, of which 912 respondents were male and 615 were female.

Data Analysis Procedures

Frequencies were calculated for each question of the survey. Additionally, responses to topical questions were cross-tabulated against selected demographic questions to identify possible patterns and trends. The group of questions consisting of the same statements first about mathematics and then about science were cross-tabulated against each other and evaluated for the degree to which mathematics questions correlated with the identical science questions. Statistical analyses, predominantly chi-square, Spearman rank correlations, and binomial tests, were conducted where appropriate.

Chi-square statistics were calculated for cross-tabulated data to determine whether the sample proportions obtained for each descriptive category differed significantly from what would be expected. In the majority of cases, it was assumed that proportions for each category would be equal. When a significant difference was found, the data were examined to identify where the specific differences occurred. Specific cell frequencies were compared to overall proportions for each category of the variable being evaluated to identify obvious discrepancies.

Two types of correlation tests were used. The Pearson correlation (r) was utilized to identify whether a linear relationship existed between two variables. This statistic is best used for numerical variables or for a comparison of responses to a question by demographic grouping. A positive correlation indicates that both variables under examination increase or decrease together. A negative correlation indicates an inverse relationship between the variables. Namely, as one increases, the other decreases.

The Spearman rank correlation (r_s) is used to investigate relationships between ordinal data, a more appropriate test for the many questions in this survey that required respondents to use a rating scale to indicate degree of agreement or strength of belief. The Spearman correlation measures consistency of a relationship, rather than linearity. In comparing responses to two sets of similar questions, a positive Spearman correlation would indicate that respondents used similar ratings across both questions. A negative correlation would indicate that respondents differed in how they ranked each question.

Correlation coefficients were calculated by excluding cases in which no answer was provided for the variables under question. By doing so, it was possible to obtain a more accurate measure of the linear relationship between the variables.

Binomial tests of proportionality were used to determine whether observed proportions of a variable differed significantly from what one would expect to observe in the population in general. Specifically, tests of proportionality were used to determine whether the sample of respondents could be considered representative of the population of Ohio by gender and by racial or ethnic background.

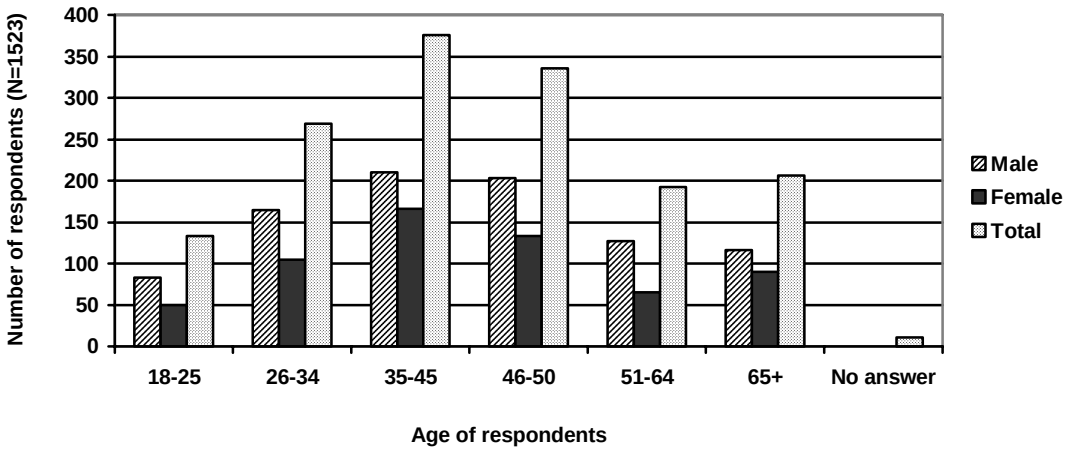
Results

A total of 1527 individuals responded to the survey. However, missing values within the data set that was provided for analysis resulted in some variables having total frequencies less than 1527. Missing values were not consistent across respondents. Rather than eliminate all respondents with missing values for any variable, it was decided that results for each variable would be reported according to the actual frequencies obtained. The total number of respondents from whom data was available has been reported for each figure and table discussed in this section.

Characteristics of Respondents

Of the total participants, 59.7% (n=912) were male and 40.3% (n=615) were female. A binomial test revealed that there were significantly more males than females participating in this survey ($Z = 7.81$, $p < .01$). The majority of respondents were between the ages of 35 and 50 (see Figure 1). See Appendices for detailed demographic information.

Figure 1. Distribution of respondents by gender and age



Proportions of respondents by race were compared to July, 1998, estimates for the state of Ohio (U.S. Census Bureau, 2000). Most respondents (88.9%) identified themselves as Caucasian, a figure comparable to the estimated proportion of 85.73% (see Table 2). Latino/Hispanic respondents made up 1.1% of respondents, a proportion comparable to the estimated proportion of 1.6%. Only 5.0% of respondents identified themselves as African American, a smaller proportion than estimated for Ohio (11.51%). A test of proportionality reveals that this difference is significant ($Z = -7.96$, $p<.001$). Asian and Pacific Islander respondents made up 0.4% of the sample compared to an estimate of 1.14% for Ohio. This difference is also significant ($Z = -2.72$, $p<.01$). Thus, the sample underrepresents African American, Asian, and Pacific Islander groups.

Table 2. Distribution of respondents by race and gender

	Survey Respondents						Estimated Ohio Population*
	Male		Female		Total*		
Race	n	%	n	%	n	%	%
African American	45	59.2	31	40.8	76	5.0	11.51
Caucasian	803	59.3	550	40.7	1353	88.6	85.73
Latino/Hispanic	11	68.8	5	31.3	16	1.1	1.6
Native American	9	52.9	8	47.1	17	1.1	.2
Asian American	4	80.0	1	20.0	5	0.3	1.14
Pacific Islander	2	100.0	0	0	2	0.1	(Asian American & Pacific Islander)
Other	18	78.3	5	21.7	23	1.5	
No answer	15	50.0	15	50.0	30	2.0	
Missing					5	0.3	
Total	**907**	**59.6**	**615**	**40.4**	**1527**	**100.0**	

Note: Percentages for gender are reported for each racial category; total percentages are reported for the entire sample

* source: Population Estimates Program, U.S. Census Bureau (August 30, 2000), www.census.gov/population/estimates/county/crh/crhoh98.txt

Professionals made up 22.8% of respondents. Over one-fifth of respondents (22.1%) reported incomes greater than $60,000 per year. Respondents reporting incomes of $25,000-39,999 made up 18.5% of the distribution while 18.3% chose not to respond (see Figure 2). The two most commonly reported occupational categories were professional (22.8%) and retired (18.3%). Sales/service and trade occupations were reported by approximately 11% of respondents. White-collar occupations were reported by another 10.2% of respondents (see Figure 3). Of respondents reporting income of $50,000 or more, 53.9% of these identified their occupations as professional.

Figure 2. Distribution of income for respondents

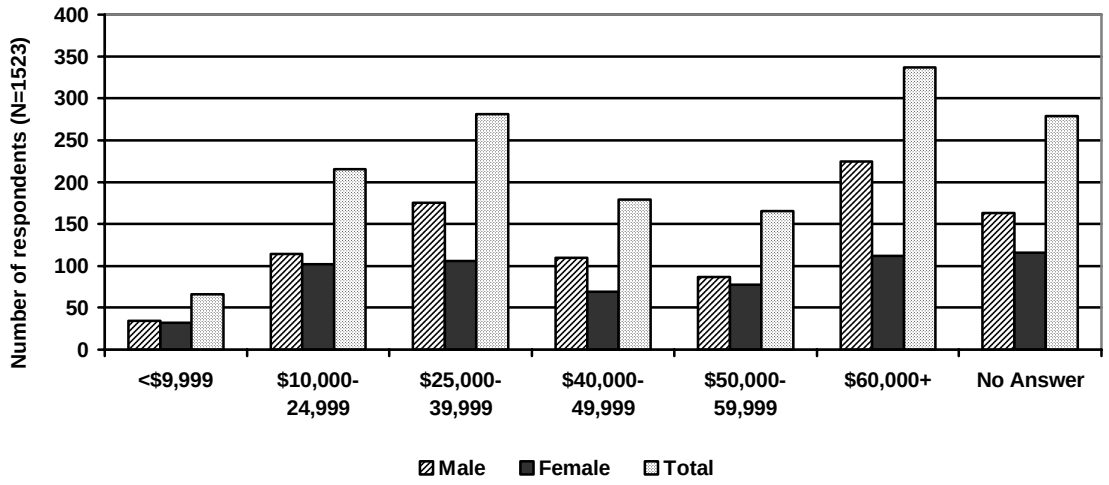
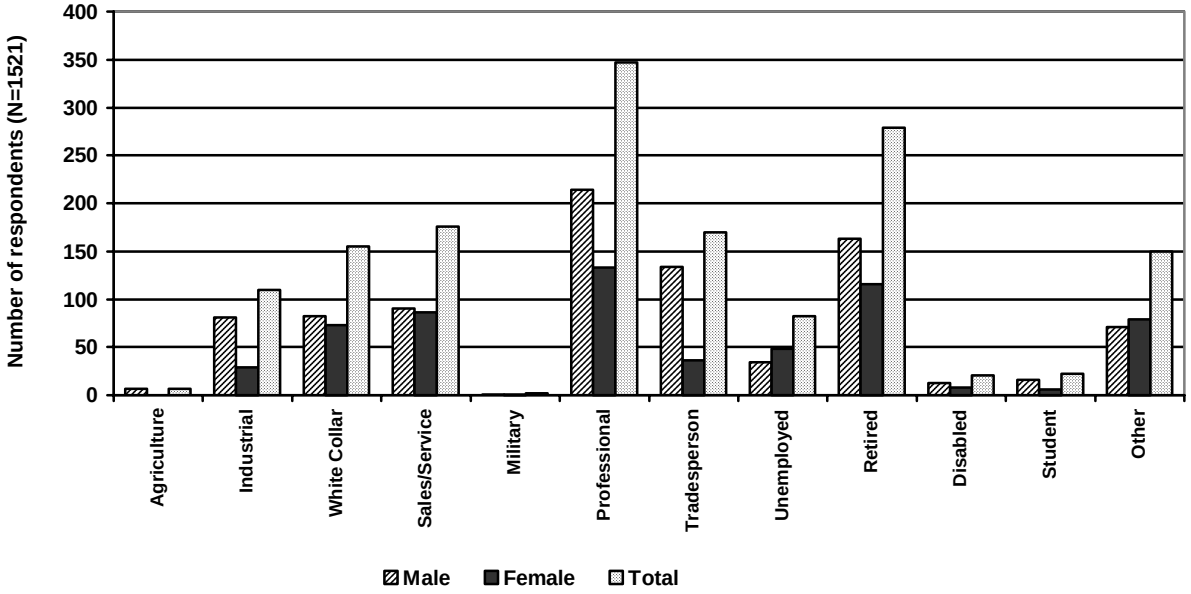


Figure 3. Occupation of respondents



Most respondents (87.3%) attended public school as children (see Figure 4). Of the 553 respondents with school-aged children, 84.6% currently send their children to public schools (see Table 3). Additionally, 76.8% of parents with school-aged children in public school attended public schools themselves. It should be noted that parents of school-aged children only made up 36.3% of the total sample. There were almost twice as many participants without school-aged children (63.7%).

Figure 4. School type respondents attended

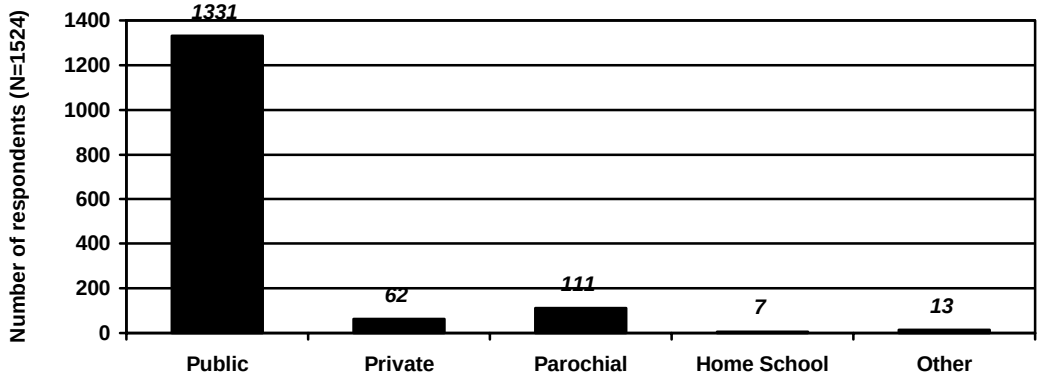


Table 3. Respondents with school-aged children by type of school children attend

Participant status	n	%	Total	%
Without school-aged children			967	63.5
With school-aged children			553	36.3
In public school	468	84.6		
In private (non-parochial) school	30	5.4		
In parochial school	41	7.4		
Home schooled	10	1.8		
In other school situation	2	0.4		
Did not answer	2	0.4	2	0.2
Total	**553**	**100.0**	**1523**	**100.0**

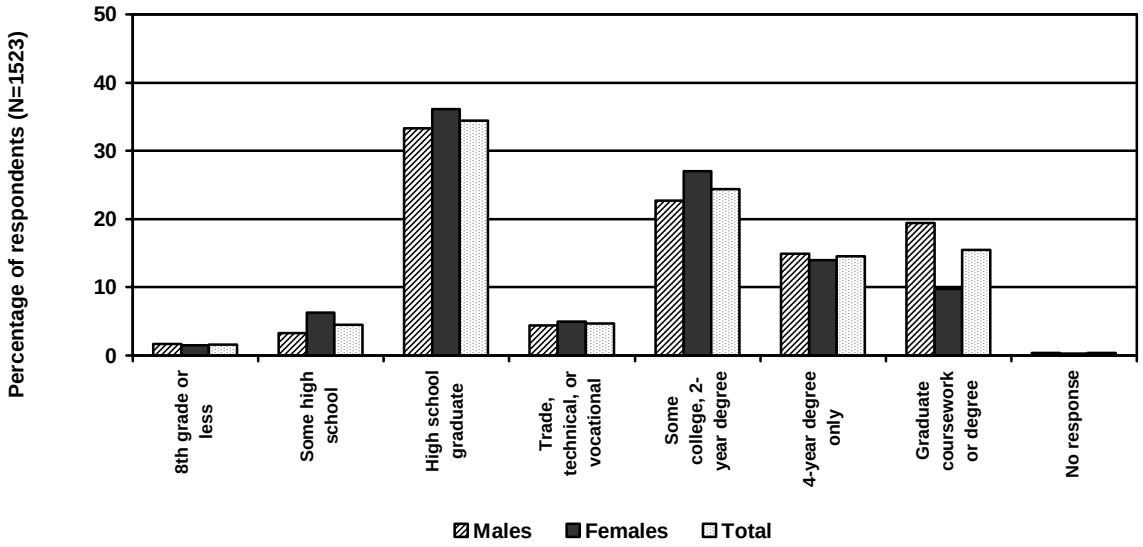
When educational attainment of respondents was evaluated, it was found that the proportions of respondents were fairly evenly distributed among high school graduates (34.4%), some college or technical training (29.1%), or four-year college degrees (30%). Of those with a four-year college degree, about half had also completed graduate school coursework or a graduate degree (see Table 4).

Table 4. Educational attainment of respondents

Highest level of education completed	Male		Female		Total	
	n	%	n	%	n	%
8th grade or less	15	1.7	9	1.5	24	1.6
Some high school	30	3.3	39	6.3	69	4.5
High school graduate/GED	302	33.3	222	36.1	524	34.4
Trade, technical, or vocational training beyond high school	40	4.4	31	5.0	71	4.7
Some college, including junior, community, or 2-year degree	206	22.7	166	27.0	372	24.4
Undergraduate (4-year) degree	135	14.9	86	14.0	221	14.5
Graduate coursework or degree	176	19.4	60	9.8	236	15.5
No response	4	0.4	2	0.3	6	0.4

Gender differences were significant ($\chi^2_{(df=7,\ n=1523)}=33.76$, $p<.05$). The proportion of male respondents who reported having pursued graduate education was twice that of females (19.4% of males, 9.8% of females). The proportions of respondents with a four-year degree were similar (14.9% of males, 14% of females). In almost all other categories, the proportion of females was greater than the proportion of males, although not significantly so (see Figure 5).

Figure 5. Educational attainment of respondents by gender



Elements of a Quality Mathematics and Science Education

Two sets of survey questions addressed this research question. Detailed frequency tables for each question are presented in Appendix C. Cross-tabulations are presented in the Appendices.

The first set of questions required participants to rate their agreement with four statements about teaching, proficiency, and the utility of mathematics and with four matching statements about science. Overall, a large majority of respondents expressed the belief that education in mathematics and science has practical value. They agreed that mathematics and science should help students make sense of the world around them (94.1%). They also agreed that mathematics and science had value in the workplace and the economy (92.3%, math; 81.7% science). Additionally, they expressed the belief that improvements in mathematics and science education would improve children's job opportunities (94.4%, math; 85.2%, science). It should be noted that, on average, mathematics was valued by a slightly higher percentage of respondents than science (see Figures 6 and 7).

Figure 6. Respondents' beliefs that mathematics has practical value

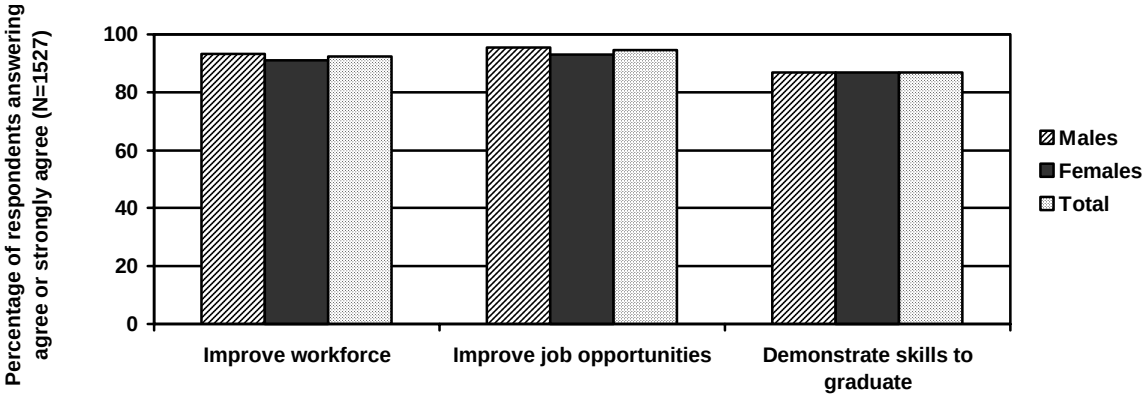
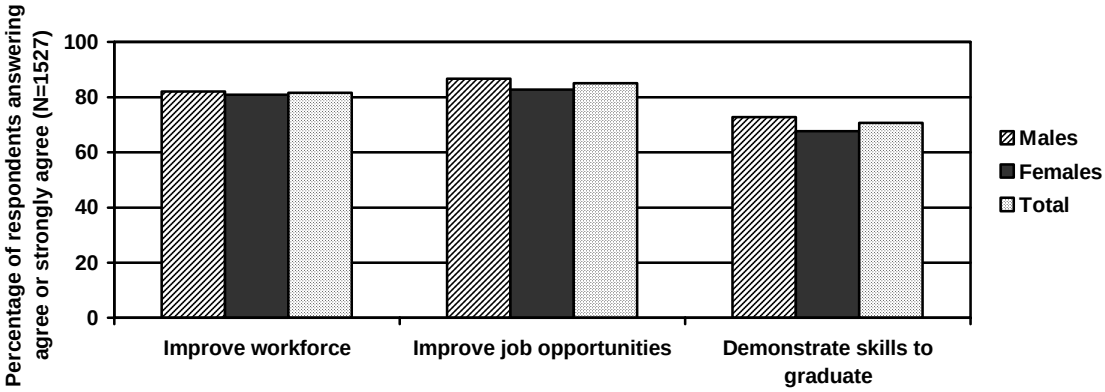


Figure 7. Respondents' beliefs that science has practical value



Cross-tabulations by gender and region revealed that, while overall gender differences were slight, males in Region 6 (Seneca, Huron, Wyandot, Crawford, Richland, Marion, Morrow, and Knox counties) were more likely than females to agree that mathematics and science had value in the workplace and the economy (males: 97%, mathematics and 87%, science; females: 87.1%, mathematics and 67.8%, science). In fact, females in this region were twice as likely as males to express disagreement with these statements (females: 6.5%, mathematics and 19.4%, science; males: 2%, mathematics and 10%, science). Comparing mathematics and science, larger proportions of both groups indicated agreement that mathematics had value in the workplace and economy.

Analysis of the effects of educational attainment revealed a significant positive correlation between level of education attained by respondents and their ratings of

agreement with the three statements about science (see Table 5). Correlations between educational attainment and the three similar statements about mathematics were not significant. In general, the higher the level of educational attainment, the more likely respondents were to agree with these statements. For the science statements, the relationship was significant. For mathematics statements, the relationship was present but was not significant. The one exception concerned the need to demonstrate mathematics skills before graduation. A larger proportion of individuals reporting trade, technical, or vocational training agreed with this statement than any other group (94.4% for trade/technical/vocational; a range from 83.3% to 87.7% for all others).

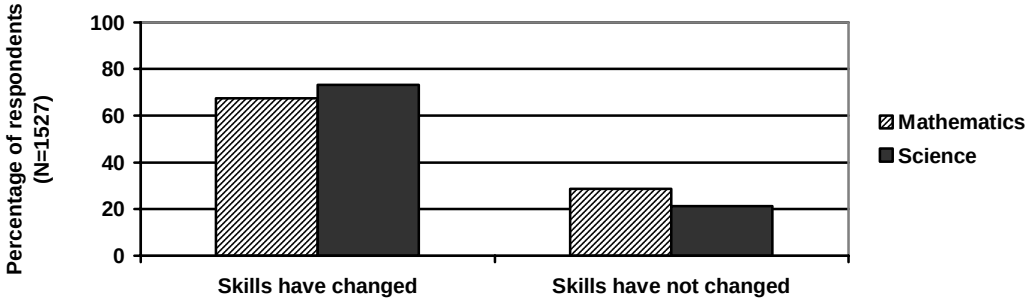
Table 5. Pearson correlations between educational attainment of respondents and agreement with statements that mathematics and science have practical value

	Mathematics		Science	
Statement	**Pearson R**	**p**	**Pearson R**	**p**
Improve the workforce	.012	.64	.120	.01
Improve job opportunities	.011	.68	.113	.00
Demonstrate skills to graduate	-.022	.39	.102	.00

Correlations are considered significant at p<.05

When asked whether they believed that basic mathematics and science skills have changed over the past 30 years, a little over two-thirds of the respondents expressed the belief that the basic skills needed in mathematics and science have changed (67.6%, math; 73.1% science). Approximately one-fourth of respondents (28.8%, math; 21.3%, science) did express the belief that the basic skills needed have not changed over the past 30 years (see Figure 8).

Figure 8. Respondents' beliefs about changes in essential mathematics and science skills



When educational attainment was taken into account, differences emerged between respondents' beliefs about changes in basic skills for mathematics and science (see Figures 9 and 10). The higher the level of educational attainment, the less likely respondents were to express the belief that science skills have not changed in the past 30 years (r = -.094, n = 1517, p<.01, two tails). With respect to mathematics skills, a larger proportion of respondents with technical, trade, or vocational training or with some college expressed the belief that those skills had changed in the past 30 years. Additionally, for both subject areas a larger percentage of individuals with educational attainment of 8th grade or less chose not to answer this question than any other group (8.3% for mathematics and 25.0% for science versus a range from 0.4% to 4.2% for mathematics and 1.3% to 5.6% for science).

Figure 9. Respondents' beliefs about changes in essential mathematics skills by level of educational attainment

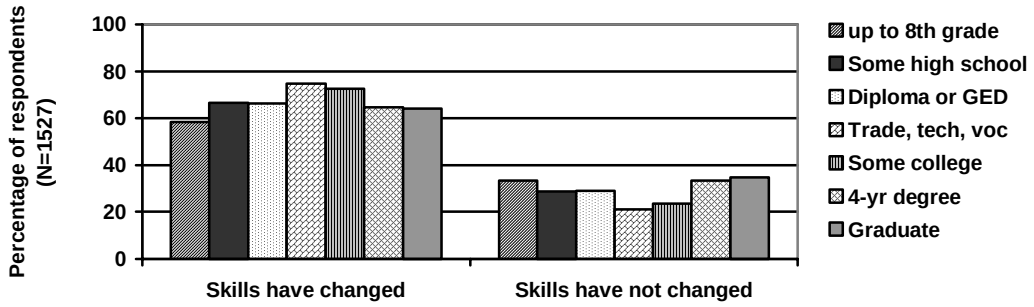
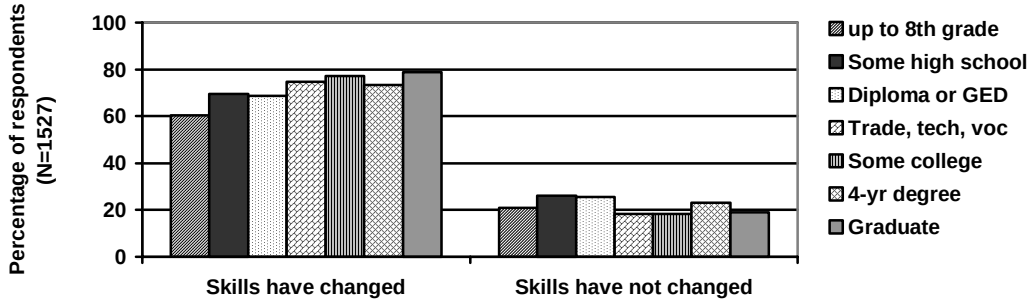


Figure 10. Respondents' beliefs about changes in essential science skills by level of educational attainment



Cross-tabulation of the four mathematics questions to the four science questions revealed an expected overall pattern of similar responses to the mathematics-science matches. Spearman rank correlations for each matching pair confirmed that respondents

expressed similar beliefs for mathematics as they did for science (see Table 6). No patterns were revealed with respect to specific demographic factors. However, a gender by region analysis did reveal that males in Region 4 (Darke, Preble, Montgomery, Greene, Clark, Champaign, Logan, Shelby, and Miami counties) were much more likely than females in that region to express the belief that science skills had not changed significantly in the past 30 years (31.8%, males; 13.6% females). This did not hold for mathematics skills. In the case of mathematics skills, males in Region 3 (Paulding, Putnam, Hancock, Hardin, Allen, Auglaize, Mercer, and VanWert counties) were more likely than females in that region to express the belief that mathematics skills had not changed (40% males; 23.1% females).

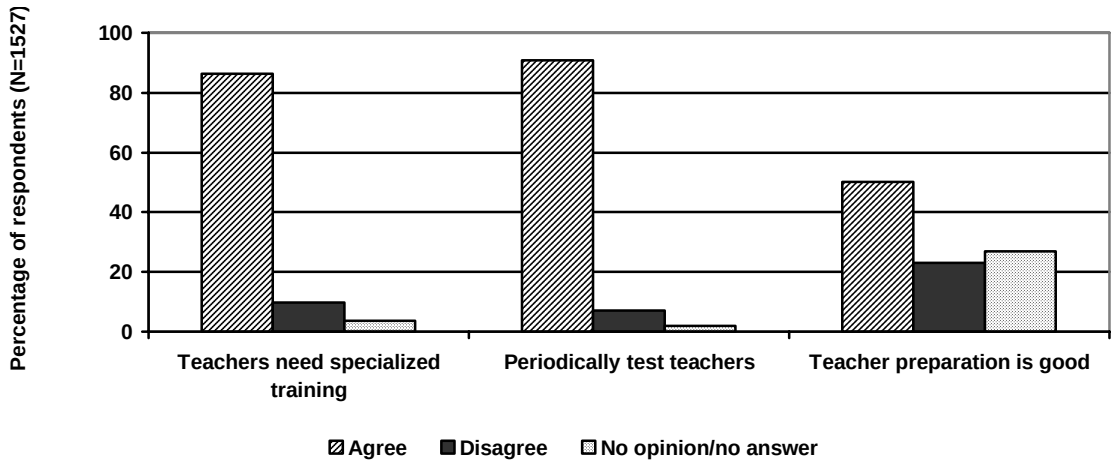
Table 6. Spearman rank correlations for responses to matching mathematics and science questions

Matched Questions	Spearman Correlation	Significance
Improving (science/mathematics) education will improve the quality of Ohio's workforce and economy	.382	p < .01
The basic (science/mathematics) skills that all students need are no different today than they were 30 years ago	.458	p < .01
Students should be required to show that they have strong (science/mathematics) skills before they graduate	.474	p < .01
Improving (science/mathematics) in our schools will improve my children's chances to have better jobs	.364	p < .01

With respect to teaching mathematics and science, 86.3% of respondents felt that elementary teachers should have specialized training to teach mathematics and science (see Figure 11). Agreement with this statement increased as respondent age increased. The Pearson correlation for responses by age was significant (r = +.097, n = 1527, p < .01, two tails). However, agreement with this statement decreased as level of educational attainment increased. The Pearson correlation for responses by education was significant (r = -.059, n = 1527, p < .02, two tails). In general, as level of educational attainment increased, respondents were less likely to agree that teachers should have specialized training to teach mathematics and science.

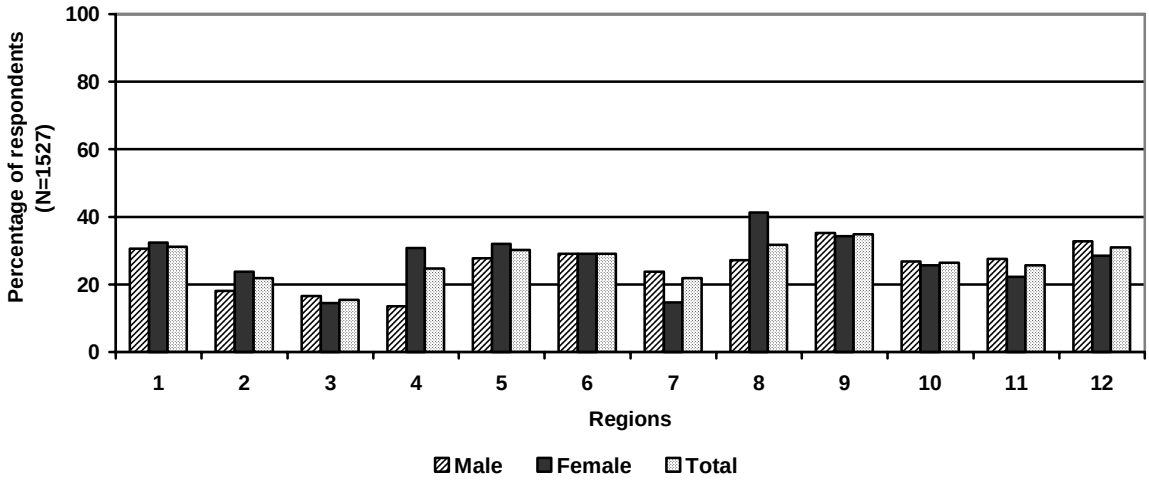
In general, respondents expressed the belief that teachers should be periodically tested with respect to their knowledge and teaching of mathematics and science (90.9%). However, as level of educational attainment increased, respondents were less likely to agree with this statement (r = -.165, n = 1527, p < .01, two tails).

Figure 11. Respondents' beliefs concerning teacher preparation and accountability



Only 50% of respondents expressed the belief that colleges and universities were doing a good job of preparing teachers in mathematics and science. It should be noted that 26.8% of respondents were either neutral or chose not to answer this question, as compared to 3.7% or less for the others (see Figure 12).

Figure 12. Respondents not expressing an opinion on teacher preparation by region and gender



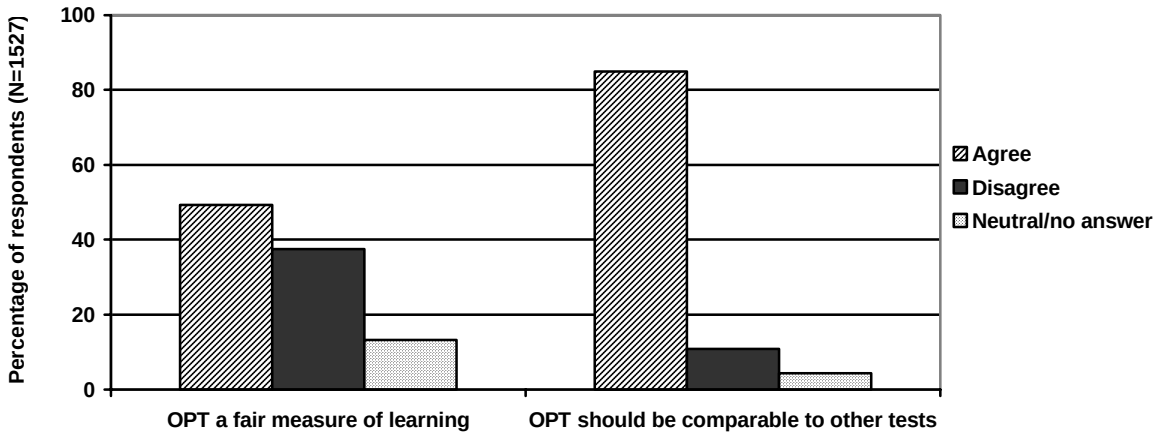
Cross-tabulations on demographic factors revealed that respondents aged 65 and older were more likely than other age groups to be neutral or to not answer this question

(37.9% compared to 27.1% or less for the other age groups). Additionally, respondents with college degrees were most likely to be neutral or to not answer this question (32.1% compared to a range of 21.2-29.2% for other levels of educational attainment). More than 20% of respondents in all regions with the exception of Region 3 (Paulding, Putnam, Hancock, Hardin, Allen, Auglaize, Mercer, and VanWert counties) were either neutral or chose not to answer this question (Region 3: 15.5%). In general, relatively equal proportions of males and females in each region were either neutral or chose not to respond (see Figure 9) with the exception of females in Regions 4 (Darke, Preble, Montgomery, Greene, Clark, Champaign, Logan, Shelby, and Miami counties) and 8 (Lake, Geauga, Cuyahoga, and Lorain counties), who were much more likely than males to be neutral or to choose not to answer this question (Region 4: 41.4% females, 27.1% males; Region 8: 30.8% females, 13.6% males).

When asked, respondents most commonly indicated that they felt they lacked the expertise to judge whether or not colleges and universities were doing a good job of preparing teachers. Cross-tabulations also revealed that individuals wishing to spend less money on school tax support were also more likely to disagree that teachers were being adequately prepared (31.5% for those wishing to spend less versus 24.9% and 20.3% for those willing to spend more or the same, respectively).

While 84.9% of respondents expressed the belief that Ohio's mathematics and science proficiency tests (OPT) should be comparable with other state and national tests, only 49.2% felt that the proficiency tests were a fair measure of how well students actually learn science and mathematics (see Figure 13). In fact, of the 37.4% who disagreed with this statement, 61.3% of these respondents (22.9% overall) expressed strong disagreement that proficiency tests were a fair measure of student learning, an equivalent proportion to those expressing strong agreement.

Figure 13. Respondents' beliefs concerning proficiency tests in mathematics and science



Analysis by education revealed a significant negative correlation between level of educational attainment and agreement that proficiency tests are a fair measure of student learning (r = -.130, n = 1361, p<.01, two tails). The higher the level of educational attainment, the greater the proportion of respondents disagreeing with this statement.

Cross-tabulations revealed that individuals preferring to spend less money on school tax support were somewhat more likely to express disagreement that proficiency tests are a fair measure of student learning (45.2% versus 37.9% and 36.6% for those willing to spend more or the same). Additionally, as respondents' age increased, so did their likelihood of choosing not to answer this question. Parents of school-aged children also disagreed with this question (40.7% disagree, 50.3% agree).

Analysis by gender and region did not show overall gender effects but did reveal that males in Regions 1 (Franklin, Delaware, Licking, Union, Madison, and Pickaway counties) and 6 (Seneca, Huron, Wyandot, Crawford, Richland, Marion, Morrow, and Knox counties) were much more likely than females to agree that proficiency tests were a fair measure of student learning (Region 1: 51.8% males versus 30% females; Region 6: 51% males versus 29.1% females). The reverse held true for Region 4 (61.8% females versus 45.4% males). Overall, with the exception of Region 11 (Fairfield, Perry, Morgan, Washington, Monroe, Hocking, Athens, Vinton, and Meigs counties), more respondents in all regions expressed agreement with this statement than disagreement. The reverse was true in Region 11, where 45.2% expressed disagreement versus 36% expressing agreement. In the case of Region 11, the largest proportion of respondents who disagreed that proficiency tests are a fair measure of learning were parents of school-aged children (Parents: 56.4% disagree, 30.7% agree; Non-parents: 41.2% disagree, 38.8% agree). When income was also considered, the parents of school-aged children with annual incomes less than $10,000 (62.5% disagree, 37.5% agree) or more than $50,000 (66.6% disagree, 25% agree) had the largest proportion in disagreement with this question.

Courses and Skills Students Should Master

Almost all respondents identified basic arithmetic (97.9%) as coursework that should be required for all students before graduation from high school. A large majority of respondents identified biology (73.6%) and algebra (71.5%) as essential courses (see Figures 14 and 15). Statistics, physics, and chemistry were more likely to be identified as not necessary for graduation. The most important skills identified were reasoning and problem-solving (94.7%). Knowing how to communicate and explain mathematics (74.9%) and using calculators and computers to do mathematics (70.7%) were identified by most respondents. Respondents were almost equally divided as to the importance of completing a scientific research project before graduation (52.1%, yes; 45.6%, no). Courses and skills by rank order may be found in Table 7.

Figure 14. Respondents' beliefs regarding required mathematics coursework and skills

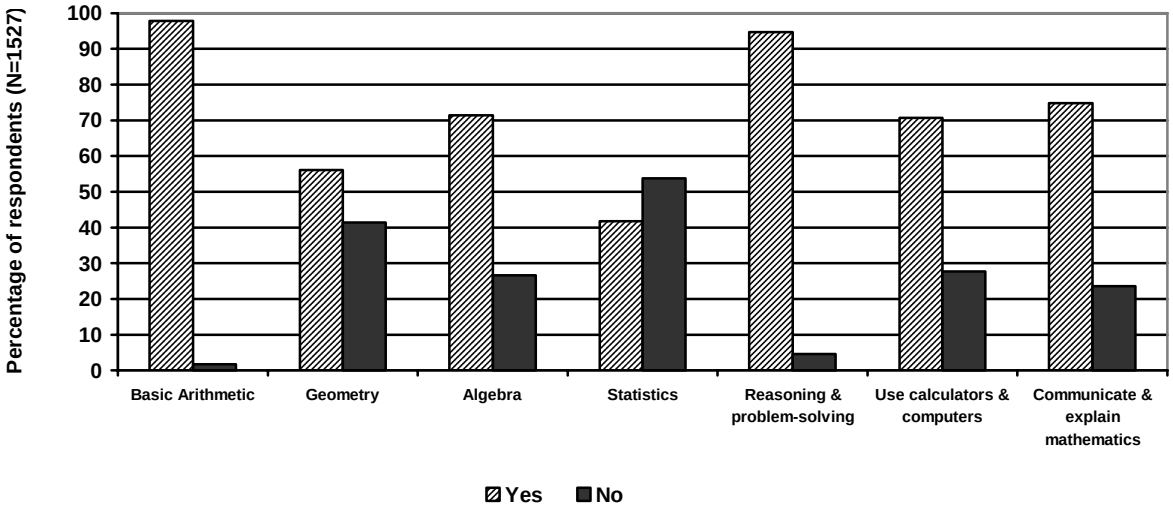


Figure 15. Respondents' beliefs regarding required science coursework and skills

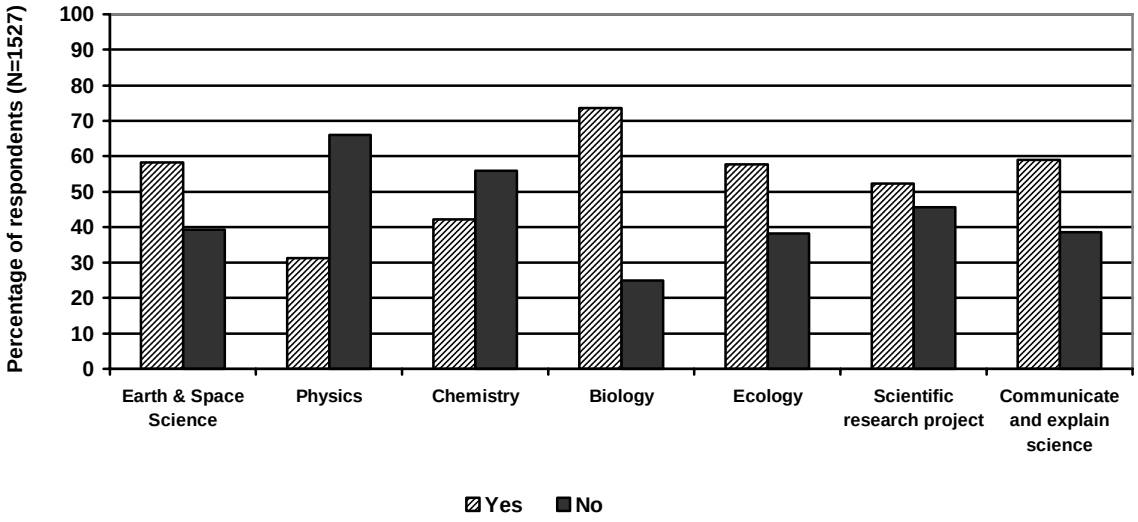


Table 7. Importance of mathematics and science courses and skills by rank order

Item	Yes		No		No Answer	
	n	%	n	%	n	%
Coursework						
Basic Arithmetic	1495	97.9	28	1.8	4	.2
Biology	1124	73.6	382	25.0	21	1.4
Algebra	1092	71.5	406	26.6	29	1.9
Earth & Space Science	891	58.3	599	39.2	37	2.5
Ecology	879	57.6	584	38.2	64	4.2
Geometry	856	56.1	633	41.5	38	2.5
Chemistry	645	42.2	852	55.8	30	2.0
Probability & Statistics	637	41.7	821	53.8	69	4.5
Physics	476	31.2	1008	66.0	43	2.8
Skills						
Reasoning and problem-solving	1446	94.7	72	4.7	9	.6
Knowing how to communicate & explain mathematics	1143	74.9	361	23.6	23	1.5
Using calculators & computers to do mathematics	1080	70.7	423	27.7	24	1.6
Knowing how to communicate & explain science	900	58.9	589	38.6	38	2.5
Completing a scientific research project	795	52.1	697	45.6	35	2.3

Analysis of responses by age group revealed that arithmetic was consistently ranked first as a course that should be required for graduation from high school (see Figure 16). Physics was ranked last with the majority of respondents in all age groups believing that it should not be a required course. Each group identified the same top three courses – arithmetic, algebra, and biology – although not necessarily in the same order. Ecology was more likely to be identified by older respondents as an important skill. Younger respondents were more likely to prefer geometry over ecology. Earth and space science were more highly preferred by those age 50 and under. Only individuals age 65 and above ranked statistics among the top 6 courses. Cross-tabulations on other variables did not produce rankings that differed by demographic group.

Figure 16. Rank ordering of courses by age of respondents

18-25	26-34	35-45
Arithmetic	Arithmetic	Arithmetic
Algebra	Algebra	Algebra
Biology	Biology	Biology
Geometry	Geometry	Ecology
Earth & Space Science	Earth & Space Science	Earth & Space Science
Chemistry	Ecology	Geometry
Statistics	Chemistry	Chemistry
Ecology	Statistics	Statistics
Physics	Physics	Physics

46-50	51-64	65+
Arithmetic	Arithmetic	Arithmetic
Biology	Biology	Biology
Algebra	Algebra	Algebra
Ecology	Ecology	Ecology
Earth & Space Science	Geometry	Geometry
Geometry	Earth & Space Science	Statistics
Chemistry	Chemistry	Earth & Space Science
Statistics	Statistics	Chemistry
Physics	Physics	Physics

Analysis of course rankings by level of educational attainment revealed that, again, arithmetic was consistently ranked first by all groups (see Figure 17 for ranks and Appendix H for details by level of education). With the exception of respondents with an 8th grade education or less, arithmetic, algebra, and biology were consistently ranked as the top three courses that should be required for graduation. Physics was consistently ranked last with less than half of those groups agreeing that this course should be required for graduation. Statistics and chemistry also ranked low on the list for each group. Individuals with an 8th education or less ranked the four mathematics courses highest. Physics and biology, the highest ranked of the science courses, received the next highest rankings.

The three skills considered the most important by all groups with the exception of those with some high school and those with 8th grade or less, were reasoning and problem-solving, knowing how to communicate and explain mathematics, and using calculators and computers to do mathematics. Knowing how to communicate and explain science and completing a scientific research project were considered important for graduation by 48-60% of respondents within those same groups. Completing a research project was ranked last by those in the 8th grade group. Respondents with some high school felt that using calculators and computers and knowing how to communicate and explain science were the least important of the skills (see Figure 18).

Figure 17. Rank ordering of courses by respondents' level of educational attainment

Up to 8th grade	Some HS	HS diploma/GED	Trade/tech/voc
Arithmetic	Arithmetic	Arithmetic	Arithmetic
Algebra	Algebra	Biology	Algebra/Biology (tie)
Geometry/ Statistics (tie)	Biology	Algebra	Earth & Space Science
Biology/Physics (tie)	Geometry	Ecology	Ecology/Geometry (tie)
Chemistry	Earth & Space Science	Earth & Space Science	Statistics
Earth & Space Science	Statistics	Geometry	Chemistry
Ecology	Chemistry	Statistics	Physics
	Ecology/Physics (tie)	Chemistry	
		Physics	

2-yr college	4-yr degree	Graduate
Arithmetic	Arithmetic	Arithmetic
Biology/Algebra (tie)	Biology	Biology
Earth & Space Science	Algebra	Algebra
Ecology	Earth & Space Science	Ecology
Geometry	Geometry	Earth & Space Science
Chemistry	Ecology	Geometry
Statistics	Chemistry	Chemistry
Physics	Statistics	Statistics
	Physics	Physics

Figure 18. Rank ordering of skills by respondents' level of educational attainment

Up to 8th grade	Some HS	HS diploma/GED	Trade/tech/voc
Communicate & explain math	Reasoning & problem-solving	Reasoning & problem-solving	Reasoning & problem-solving
Reasoning & problem-solving	Communicate & explain math	Communicate & explain math	Communicate & explain math
Communicate & explain science	Completing a research project	Using calculators & computers for math	Using calculators & computers for math
Using calculators & computers for math	Communicate & explain science	Communicate & explain science	Completing a research project
Completing a research project	Using calculators & computers for math	Completing a research project	Communicate & explain science

2-yr college	4-yr degree	Graduate
Reasoning & problem-solving	Reasoning & problem-solving	Reasoning & problem-solving
Communicate & explain math	Using calculators & computers for math	Using calculators & computers for math
Using calculators & computers for math	Communicate & explain math	Communicate & explain math
Communicate & explain science	Communicate & explain science	Communicate & explain science
Completing a research project	Completing a research project	Completing a research project

Analysis of the relationship between educational attainment and belief that a course should be required for graduation from high school revealed significant negative correlations between the two variables for seven courses (see Table 8). That is, the higher the level of educational attainment, the more likely a respondent was to believe a course should be required for graduation for high school. Significant negative correlations were also found to exist for two skills. Significant positive correlations were found for one skill and one course. In this case, the higher the level of educational attainment, the less likely a respondent was to believe a course or skill should be required for graduation.

Table 8. Pearson correlations between respondents' level of educational attainment and belief that course or skill should be required for graduation from high school

Item	Pearson r	p
Coursework		
Basic Arithmetic	-.074	.01
Biology	-.126	.00
Algebra	-.113	.00
Earth & Space Science	-.140	.00
Ecology	-.116	.00
Geometry	-.115	.00
Chemistry	-.108	.00
Probability & Statistics	+.134	.00
Physics	+.046	.10
Skills		
Reasoning and problem-solving	-.083	.00
Knowing how to communicate & explain mathematics	+.086	.00
Using calculators & computers to do mathematics	-.133	.00
Knowing how to communicate & explain science	-.030	.29
Completing a scientific research project	-.002	.95

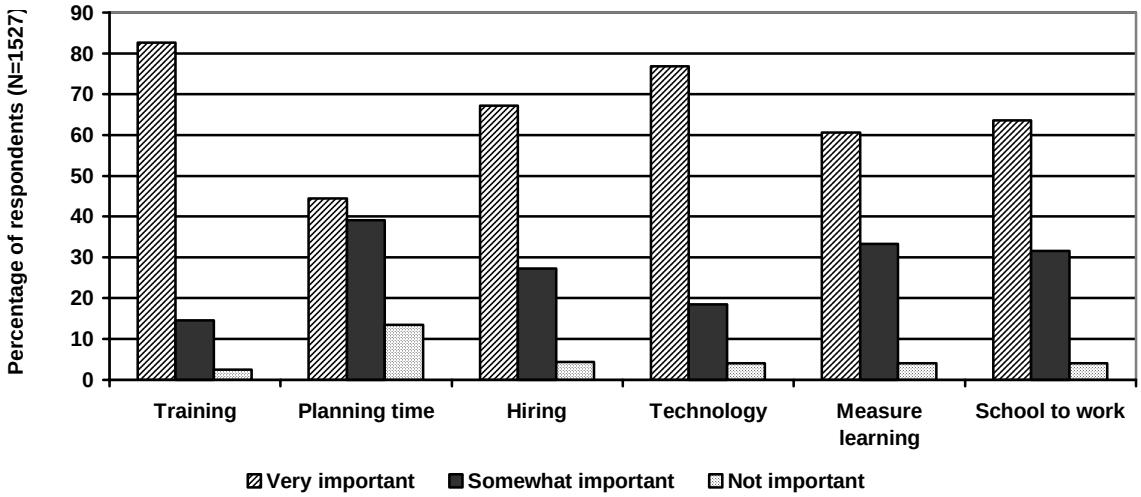
Correlation is significant at p<.05

Proposed Changes in the Delivery of Mathematics and Science Education

Overall, respondents felt that the most important changes that should be made in the delivery of mathematics and science education were to provide teachers with professional training to update their skills (82.6%), provide up-to-date computers and other technology in mathematics and science rooms (76.8%), and to hire more teachers

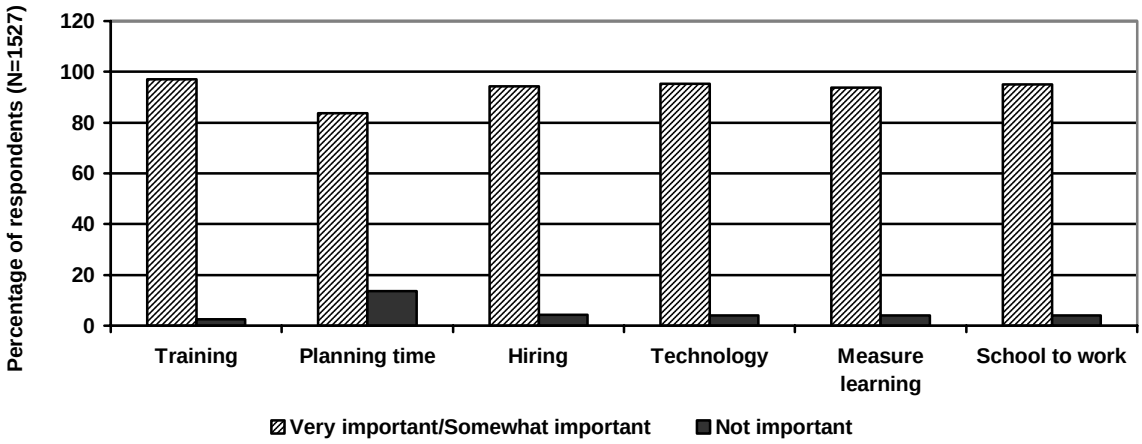
with strong backgrounds in mathematics and science (67.1%). Fewer than half (44.4%) felt that it was very important to provide teachers with more planning time (see Figure 19).

Figure 19. Respondents' ratings of proposed educational strategies



When the proportions of participants who responded with very important and somewhat important are combined, it was found that almost all respondents (97.1%) felt that professional training for teachers was an important strategy. All but one of the remaining strategies were rated as very or somewhat important by more than 90% of the respondents (hiring more teachers, 94.3%; improved technology, 95.3%; measure learning better, 93.8%; improve school to work linkages, 95.1%). More planning time for teachers was considered at least somewhat important by 83.6% of respondents (see Figure 20).

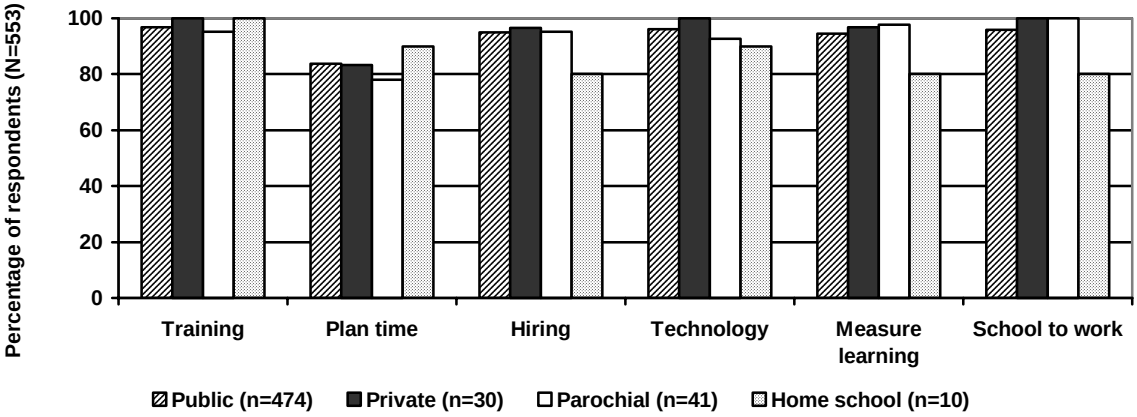
Figure 20. Ratings of educational strategies by importance



Cross-tabulation analyses yielded differences in respondent priorities on only two dimensions – type of school attended by respondent's child and level of support respondents were willing to provide to fund educational change. Parents of school-aged children made up 36.3% of the respondents (N=553). Of this group, almost all utilized some form of formal schooling. Only 10 respondents indicated that they were home schooling their children (1.8%). This proportion is so small that responses for home schoolers, although they will be presented in this analysis, should not be considered representative of home schooling parents.

All parents, except those of children in parochial schools, felt that professional training for teachers was the most important strategy (see Figure 21). Parents of private school children felt training, improved technology, and school to work linkages were equally important. Parents of parochial school children felt it was more important to build school to work linkages and to measure learning better. All but parents of home schooled children ranked increased planning time as the least important of the six options. Parents of home schooled children ranked this second along with improved technology. Parents of public school children ranked improved technology second.

Figure 21. Respondents rating strategies important by type of school child attends



While rankings remained reasonably similar, a smaller proportion of respondents who indicated they would prefer to spend less tax money than those who would spend the same or more to support changes or improvements rated any of the proposed options as important (see Figure 22). Those willing to spend more or the same were fairly consistent in their ratings of important, with increased training ranking first among the strategies. Increased planning time ranked lowest for all groups. Those preferring to spend less were also more likely to rate the options as not important than respondents who indicated they were willing to spend at levels that were either higher or the same as they were currently experiencing (see Figure 23).

Figure 22. Respondents rating strategies important by their level of willingness to spend tax monies

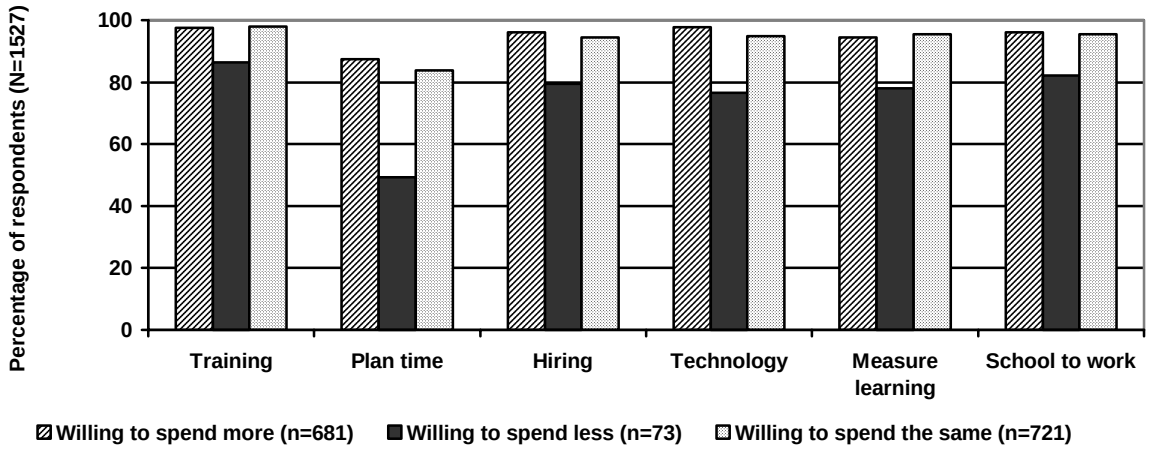
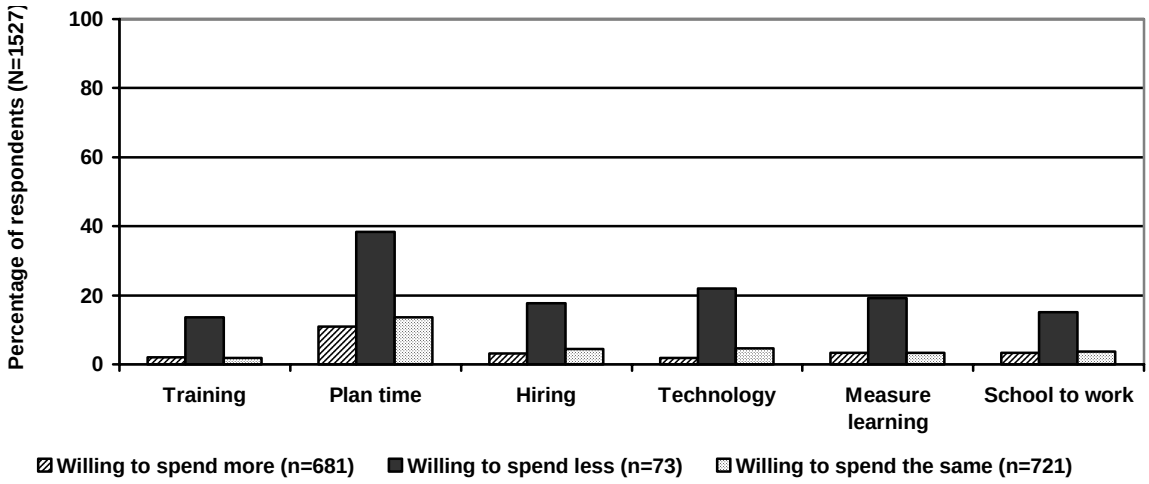


Figure 23. Respondents rating strategies as not important by their level of willingness to spend tax monies



Willingness to Support the Costs of Improvement

When asked if they had voted in the past four years, 78% of respondents indicated that they had voted at least once (see Figure 24). Cross-tabulations revealed no effects by gender or region. However, cross-tab analysis did reveal that, as respondents aged, smaller proportions of each group reported that they had not voted in the past four years (see Figure 25). Voters aged 18-25 were the only group in which a larger proportion of the group reported that they had not voted in the past four years. However, this result

could very well be due to the possibility that many in this age group were not old enough to vote during some or all of the four years prior to this survey.

Figure 24. Respondents voting in the previous four years

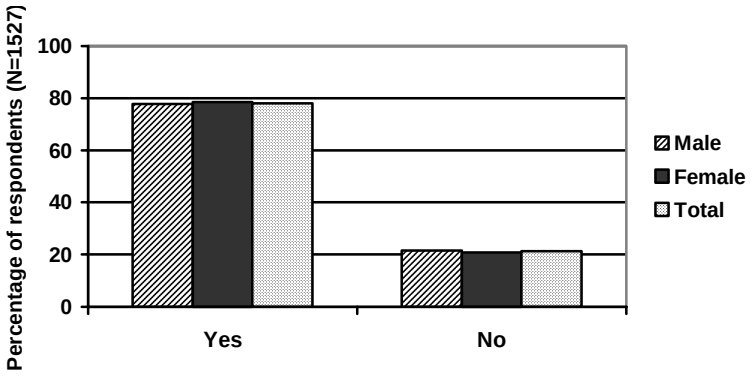
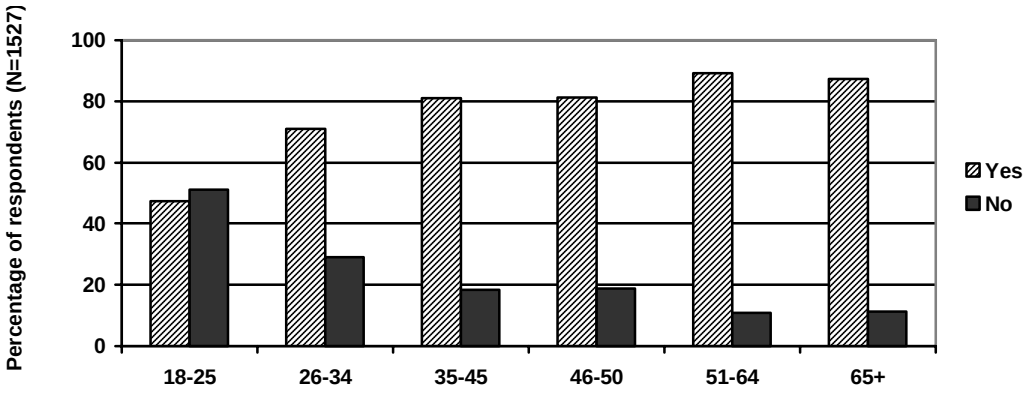
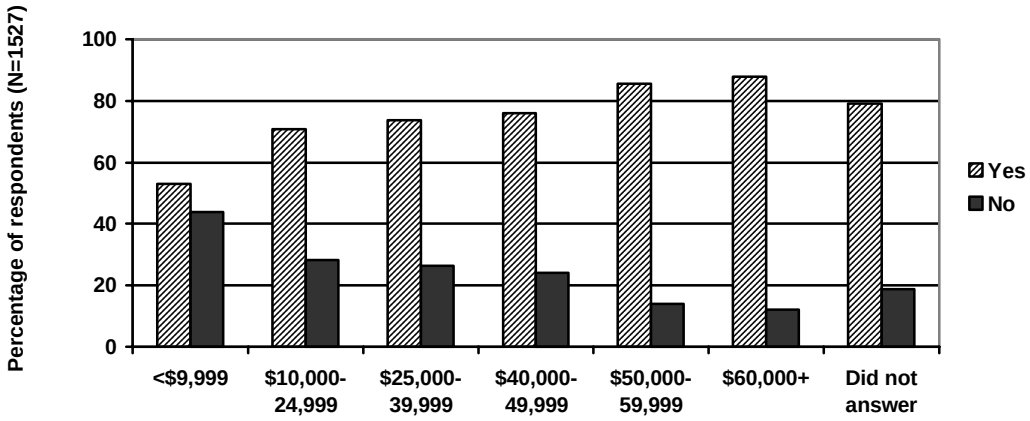


Figure 25. Voting participation by respondents' age



As income increased, a larger proportion of respondents reported that they had voted in the past 4 years (see Figure 26). The Pearson correlation for income and voting record was significant (r = -.14, n = 1521, p < .01, two tails).

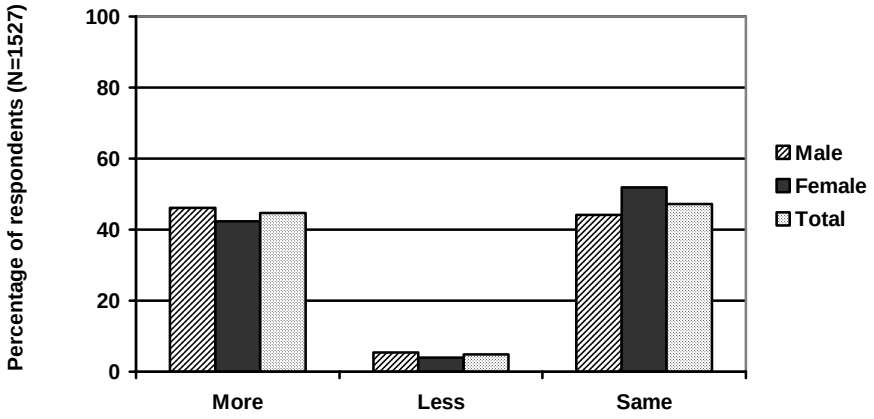
Figure 26. Voting participation by respondents' income



Additionally, as level of educational attainment increased, a larger proportion of respondents reported that they had voted in the past four years. The Pearson correlation for educational attainment and voting record was then calculated with a filter included to pull out individuals aged 18-25 whose voting participation may have been out of their control. The correlation was significant (r = -.112, n = 1390, p < .01, two tails).

Overall, very few respondents (4.8%) indicated that they would be unwilling to spend the same or more tax money to improve mathematics and science education in the state (see Figure 27). Slightly more women than men indicated they would prefer to spend the same (51.9%, women; 44.1%, men) while slightly more men indicated that they would spend more (46.2%, men; 42.3%, women). In general, though, gender differences were not significant.

Figure 27. Respondents' willingness to spend tax monies to support improvements in mathematics and science education



Respondents who had voted in the past four years were somewhat more likely to be willing to spend more to support improvements than those who had not (voters, 46.3%; non-voters, 39.9%). Few indicated they would prefer to spend less (see Figure 28).

Cross-tabulation analysis revealed that more respondents aged 18 to 45 reported that they would be willing to spend more to support educational improvements than respondents over the age of 46 (see Figure 29). This was also the group with more school-aged children (80.1% of the respondents reporting school-aged children in the home). For respondents aged 65 or older, the proportions differ greatly, with the majority preferring to spend the same. A larger proportion of older adults also indicated they would prefer to spend less (6.8%, adults 51-64 years of age; 6.3%, adults 65 and older; 4.7%, all respondents).

Figure 28. Respondents' willingness to spend by voting record over past 4 years

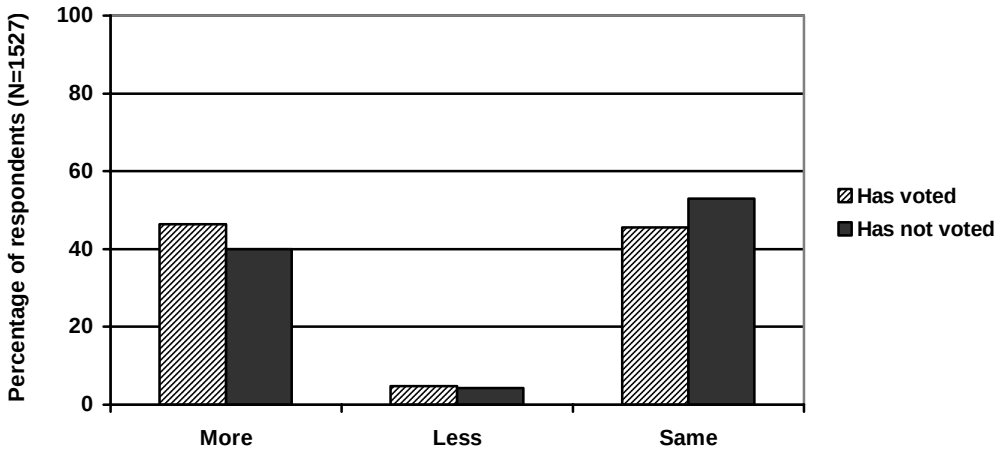
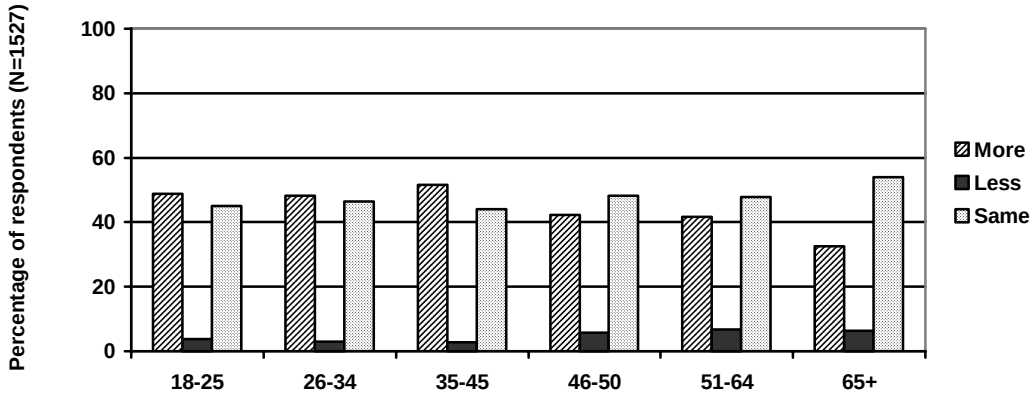


Figure 29. Amount respondents were willing to spend by age



As level of educational attainment increased, the proportion of respondents willing to spend more generally increased. At least 36% of each group, with the exception of those attaining only 8th grade (16.7%), expressed willingness to spend more (see Figure 30). Conversely, those with lower levels of educational attainment expressed a greater preference for spending to remain the same.

As income level increased, the proportion of respondents willing to spend more also increased to a high of 54.6% for respondents with incomes in excess of $60,000 (see Figure 31). On average, as income increased, fewer respondents indicated that they would be unwilling to spend more or the same tax monies on educational improvements for mathematics and science. Income was not a significant factor for those respondents who indicated they would prefer to spend less on improvements.

Figure 30. Amount respondents were willing to spend by level of educational attainment

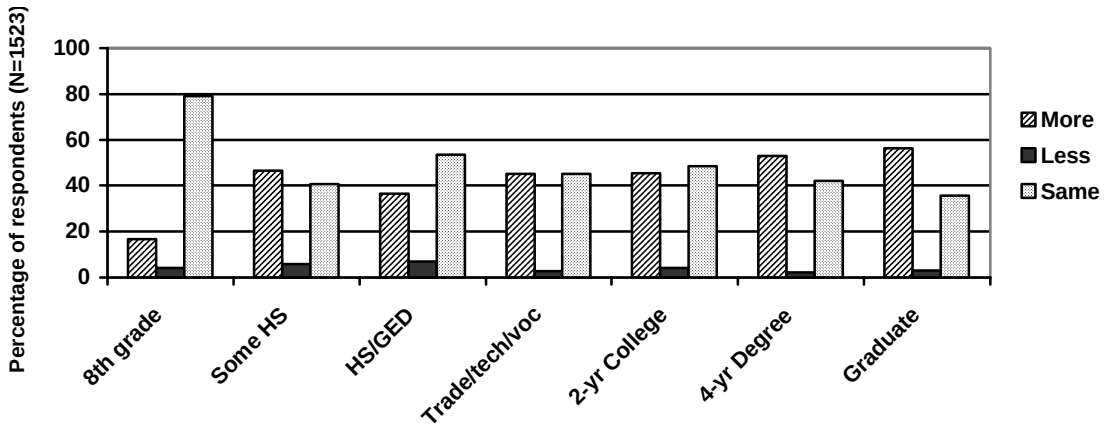
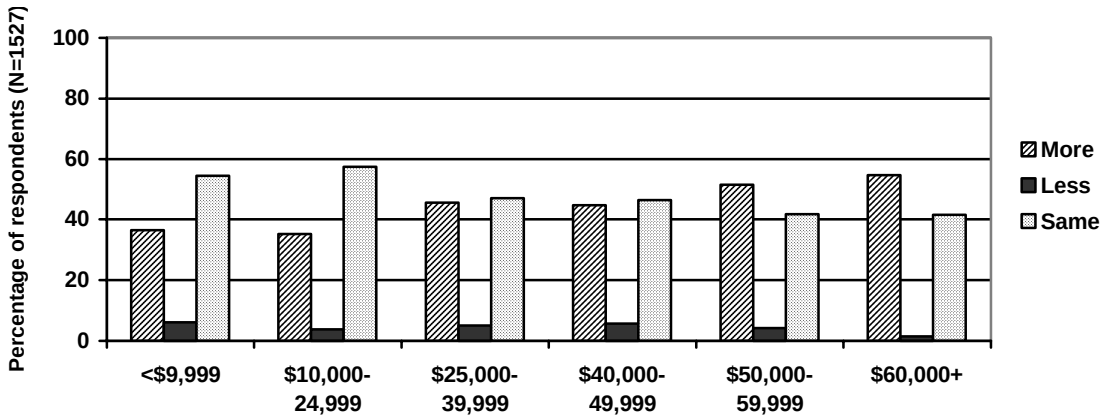
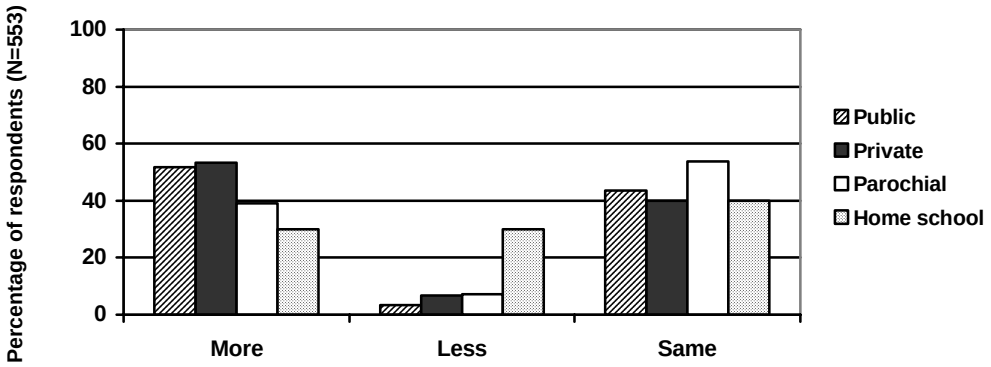


Figure 31. Amount respondents were willing to spend by level of income



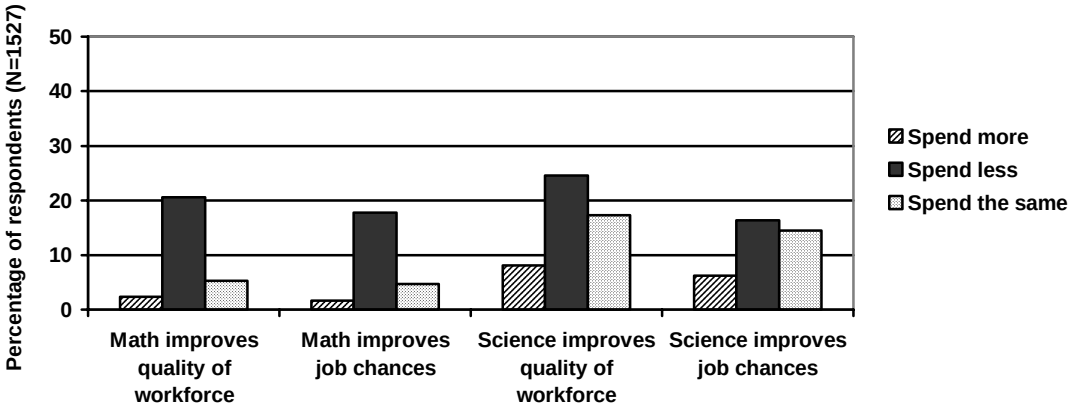
Responses of parents with school-aged children (N=553) were analyzed according to the type of schools respondents' children were attending (see Figure 32). The group that preferred spending less to support improvements were those respondents with children in private or parochial schools (6.7%, private; 7.3%, parochial). A large percentage of parents of children in private schools indicated that they would be willing to spend more tax monies on improvements. This proportion was actually greater than parents of children in public schools (53.3% private; 51.7% public; 39% parochial). Of the small group of parents who were home schooling their children (N=10), almost half (40%) would prefer to spend the same, while even proportions (30% for each) indicated they would either spend more or less.

Figure 32. Amount respondents were willing to spend by child's school type



While few respondents indicated that they would prefer to spend less tax money to support improvements, those who did were more likely to disagree with statements concerning the practical value of mathematics and science with respect to contributions to job opportunities for students and to the quality of the workforce and economy. On average, the difference between the two exceeded 10% (see Figure 33).

Figure 33. Respondents who disagree that mathematics and science have practical value by amount willing to spend



Almost all respondents (92.6%) indicated that they supported standards for teaching and learning in mathematics and science (see Figure 34). Proportions were fairly similar with a preference for standards set at the state level. Overall, 36.1% believed that standards should be set at the state level, 30.6% believed that standards should be set at the national level, and 29.6% believed that standards should be set locally (see Figure 35). Patterns of response by gender were similar. Patterns of response by region were also similar with the exception of Regions 8 (Lake, Geauga, Cuyahoga, and Lorain counties)

and 9 (Medina, Summit, Portage, Stark, Wayne, Ashland, and Holmes counties). Respondents from Region 8 indicated a preference for setting standards at the local level (36.8%) rather than state (31.6%) or national levels (28.2%). Respondents from Region 9 indicated the reverse. They preferred that standards be set at the national level (43.6%) rather than at local (23.9%) or state levels (23.1%).

Figure 34. Respondents' beliefs that standards for teaching mathematics and science should exist

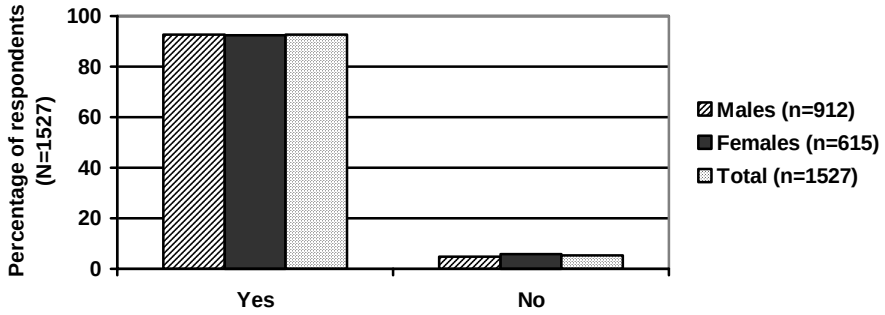
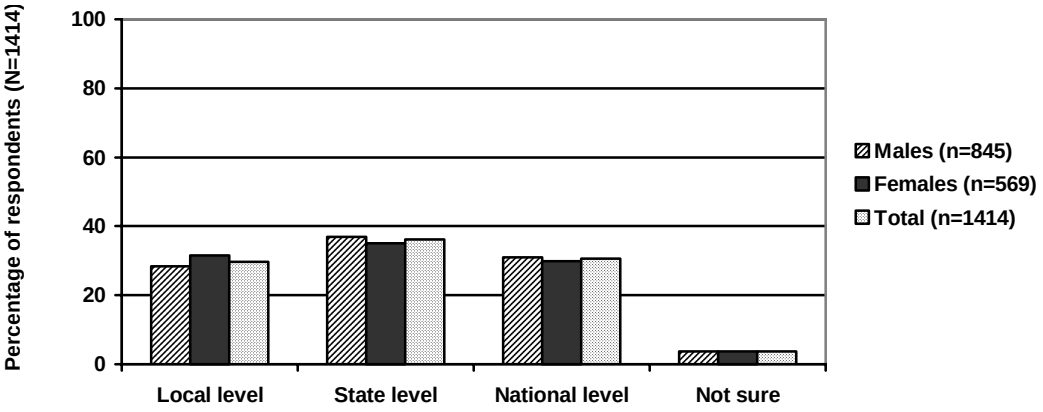
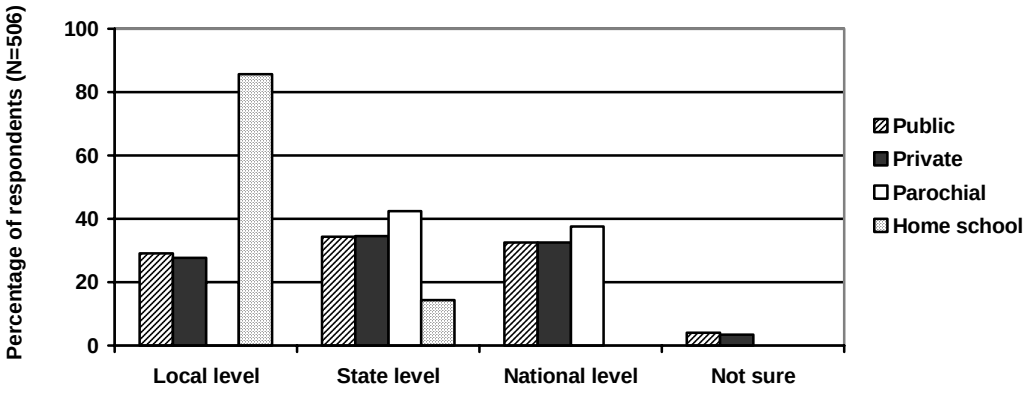


Figure 35. Respondents' beliefs about where standards should be determined



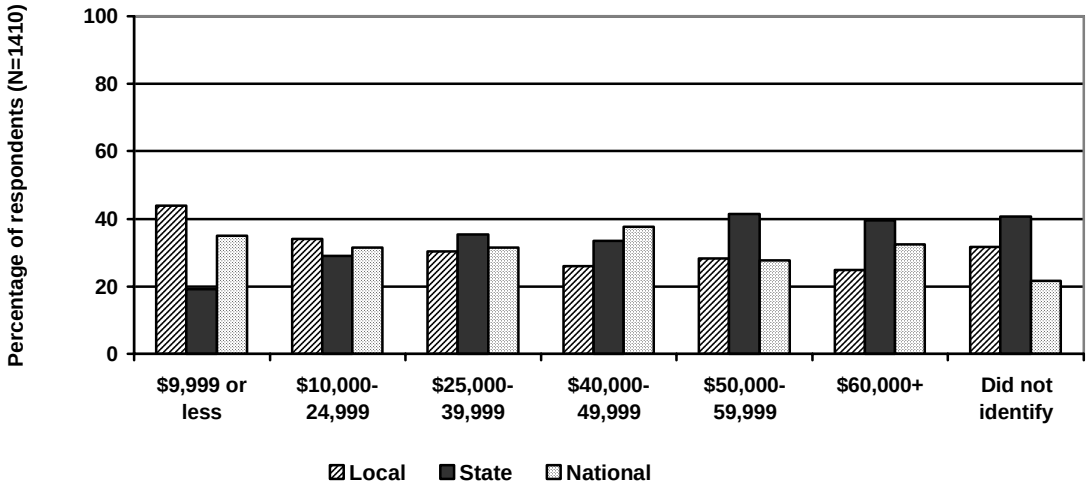
Respondents with school-aged children in public and private, non-parochial schools were fairly evenly divided with respect to where they believed standards should be set (see Figure 36). Parents of children in parochial schools preferred that standards be set at the state level (42.5%, state; 37.5%, national; 20%, local). The seven home schooling parents who answered this question were predominantly in favor of setting standards at the local level (85.7%) rather than at the state level (14.3%). No parents of home schooled children preferred that standards be set at a national level.

Figure 36. Respondents' beliefs about where standards should be determined by child's schooling



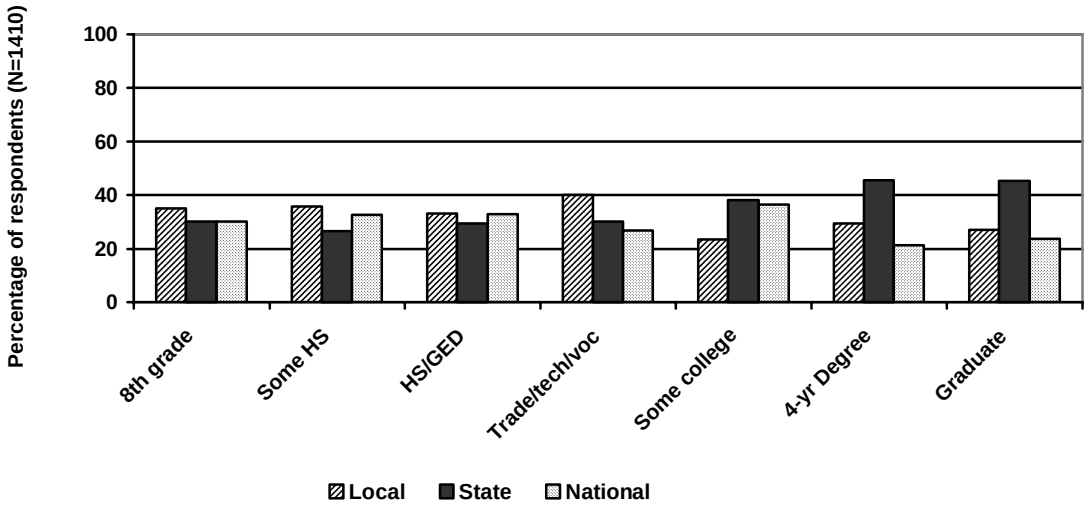
Respondents reporting incomes of less than $10,000 per year preferred that standards be set at the local level (see Figure 37). Respondents making less than $25,000 per year preferred that standards be set at local or national levels rather than at state levels. The difference was most pronounced for those with annual incomes less than $10,000. Respondents with annual incomes exceeding $50,000 and those who chose not to identify their income expressed a preference for state-level standards.

Figure 37. Respondents' beliefs about where standards should be determined by income categories



Respondents with levels of educational attainment of high school, trade, or less preferred that standards be set at the local level (see Figure 38). Respondents with college or graduate degrees preferred that standards be set at the state level.

Figure 38. Respondents' beliefs about where standards should be determined by level of educational attainment



Discussion

Respondents were predominantly Caucasian and were evenly divided across the 12 professional development regions of Ohio. The majority of respondents were between the ages of 35 and 50 years old with 22.1% reporting annual incomes greater than $60,000. The most commonly reported occupations were professional and retired followed by sales/service and trade. Almost all respondents (93.5%) had attained at least a high school diploma with a third of this group having completed four-year college degrees.

Most of the respondents attended public schools as children. Only 36.3% of respondents were parents of school-aged children. Of this group, 84.6% enrolled their children in public schools. A few respondents (1.8%) were home schooling their children, and the rest were using either parochial (7.4%) or private (5.4%) options. Due to the small number of respondents who were home schooling their children, it is not possible to make meaningful comparison between home schoolers and parents using other schooling options.

Elements of a Quality Mathematics and Science Education

Most respondents believed that mathematics and science have practical value. Mathematics had a slight edge over science, in that a greater proportion of respondents agreed with the mathematics statements than with the science statements. However, both subject areas were valued by more than 80% of respondents, on average. Almost all respondents felt that mathematics and science should help students make sense of the world around them, again emphasizing their belief in the importance of the applied aspects of mathematics and science. Educational attainment was a factor in respondents' beliefs concerning the practical value of science education. Respondents who had progressed farther in their schooling were more likely to believe in the practical value of science education than respondents with fewer years of schooling.

The majority of respondents acknowledged that the basic skills fundamental to learning and using mathematics and science have changed in the past 30 years. However, close to one-fourth of the respondents felt that these basic skills were no different than those required 30 years ago. What is not clear is whether respondents believe that the number of basic skills required have increased or decreased over the years. It is also not clear what respondents believe is different with respect to the type of skills needed.

Respondents expressed the belief that mathematics and science teachers should receive specialized training to teach these subjects and that their knowledge in these subjects should be periodically tested. As the age of respondents increased, the number expressing agreement with these two statements also increased suggesting that older individuals are more likely to recognize the need for specialized training and proficiency training for teachers. These beliefs did not correlate with educational attainment,

however. Thus, years of schooling does not appear to be a factor in respondents' beliefs about specialized professional development for teachers.

While respondents were more than willing to express opinions about the performance and skills expected of teachers, they were not prepared to evaluate the quality of the programs that prepared teachers. Only half the respondents expressed the belief that colleges and universities were doing a good job of preparing teachers in mathematics and science. However, a large number of respondents (26.8%) were either neutral in their beliefs or chose not to answer this question. The most common reason given for not expressing an opinion was lack of expertise on the part of respondents to judge the quality of teacher preparation programs. While this may suggest that the general public does not have confidence in teacher education programs, it may also indicate that this may be an area that is outside respondents' experience. Indeed, those respondents most likely to express a belief that teachers were not being adequately prepared were the ones who also indicated that they would prefer spending fewer tax monies to support educational change than they do now.

Opinion with respect to proficiency testing was mixed. Most respondents felt that Ohio's mathematics and science proficiency tests should be comparable to other state and national tests administered to students. However, barely half (49.2%) believed that proficiency testing was a fair measure of student learning, with 37.4% of respondents expressing the belief that proficiency tests are not a fair measure of learning. The more highly educated the respondent, the less likely they were to believe that proficiency tests were a fair measure of student learning. Parents of school-aged children, however, were stronger in their beliefs about proficiency testing with 40.7% expressing the belief that proficiency tests were fair measures of student learning. These results must bring into question the value of proficiency testing in the eyes of the general public. They also suggest that exploration of alternative means of assessing student learning in mathematics and science might be a worthwhile effort.

Courses and Skills Students Should Master

Almost all respondents believed that students should master basic arithmetic and reasoning and problem-solving skills in order to graduate from high school. Respondents' choices of the mathematics and science courses that should be required for graduation from high school could be classified into three groups of three courses each. Group 1 consisted of basic arithmetic, biology, and algebra. More than 70% of respondents across all demographic groups felt that these courses should be required for graduation. Group 2 consisted of earth and space science, ecology, and geometry. These courses were indicated by a small majority (50-60%) of all respondents. Group 3 consisted of chemistry, probability and statistics, and physics. Less than half of all respondents believed that these courses should be required for graduation. In fact, twice as many respondents believed that physics should not be a required course than believed that it should be required. A little more than half believed that chemistry and statistics should not be required.

Skills that should be acquired before graduation fell into two distinct groups. Group 1 consisted of the following: reasoning and problem-solving; knowing how to communicate and explain mathematics; and using calculators and computers to do mathematics. More than 70% of respondents felt that these were essential skills. Group 2 consisted of completing a scientific research project and knowing how to communicate and explain science. A little more than half of all respondents felt that these were essential skills.

Mathematics is definitely a valued subject. Two of the Group 1 courses and all the Group 1 skills are related to mathematics, although reasoning and problem-solving may be applied to science as well. More respondents believed that mathematics had practical value than believed the same for science. It is possible that mathematics is perceived as a subject that has more utility in daily life than science. This may also explain the higher value placed on mathematics-related skills than on scientific skills.

A review of the courses by rank suggests that mathematics and science courses that emphasize applied skills and readily transfer to tasks of daily living were more likely to be considered essential for high school students than those that may be considered more theoretical or specialized in their utility. The low level of support for completing a scientific research project is problematic as this may, indeed, be considered an applied skill. The combination of the words “research” and “project” in this option may have resulted in different interpretations on the part of respondents, as these two words do not necessarily imply the same type of activity. Future surveys need to first understand how respondents define these terms and should consider separating them into two discrete items on the survey. While pilot research was conducted on the survey as a whole, it might have been useful to conduct some targeted focus group research on the terminology itself to better understand how respondents define these terms for purposes of responding to a survey of this type. Targeted research into why respondents believe specific courses are considered more critical for high school students is also needed to provide insight into the specific elements of mathematics and science courses and skills that are valued by the general public.

Proposed Changes in the Delivery of Mathematics and Science Education

All proposed changes, with the exception of increased planning time for teachers, were identified as important by more than 90% of all respondents across a variety of demographic variables. However, some differences did arise when results were evaluated based on respondents’ willingness to spend tax monies to fund improvements. Individuals who indicated that they would prefer to spend less tax money were less likely to consider each strategy important than those who would be willing to spend the same or more tax money. Again, the least favored of the options was more planning time for teachers.

Given the similarity of responses across the proposed changes, it is difficult to identify one or two key changes that respondents truly preferred, with the exception of

planning time. While a very important element of effective teaching, increased planning time is the strategy least likely to produce effects that are directly observable by the general public, even parents of school-age children. Thus, while considered important, it is not valued as highly as the other options, the effects of which can be more easily observed and measured.

Willingness to Support the Costs of Improvement

Most school districts attempt to support the costs of staffing and classroom improvements through annual operating budgets, the bulk of which come from school tax levies that must be approved by voters. Most respondents indicated that they have voted in the past four years, with the proportion of those voting increasing with age as well as with income. Most respondents who indicated that they have not voted in the past four years were 18-25 years of age, although it may be assumed that a proportion of this group did not vote because they were too young at some point in the previous four years. Additionally, a large proportion of respondents with incomes less than $10,000 did not vote.

Overall, very few respondents indicated that they were unwilling to support improvements in mathematics and science education through the use of tax monies. However, it should be noted that respondents were almost equally divided between spending more and spending the same amount to support improvements. Older voters, particularly those of retirement age, were more likely to prefer maintaining current spending over increases. Voters with incomes greater than $50,000, though, were more willing to support increased spending. As these individuals were also more likely to be professionals, it is understandable that they might be more aware of the overall need for and benefits of a strong education in mathematics and science.

While these results indicate that voters may support renewal levies, it does not necessarily indicate strong support for additional levies to fund improvements in mathematics and science education. Thus, while respondents agree that mathematics and science is important and has practical value, they are not necessarily willing to support new levies to fund changes. This suggests that district, regional, and state efforts should also be turned to seeking alternative sources of funding for improvements in mathematics and science education, possibly through grants, sponsorship, or private donations.

Respondents do believe that having standards for teaching and learning in mathematics and science is important. Overall, respondents indicated a slight preference for standards set at the state level rather than at local or national levels. The only groups that indicated a stronger preference for having standards set at local levels were parents of home schooled children and individuals with incomes less than $25,000.

Limitations of the Data

Sampling is a concern with respect to regional and racial representation. For this survey, the sampling strategy used a simple quota approach to attain gender and regional equity. Representation for each of the twelve regions was equivalent, regardless of population density within each region. However, such a strategy will underrepresent regions that have higher population density in urban areas and overrepresent rural areas with lower density. It is suggested that future surveys utilize proportional quotas that reflect actual population density for each region as a percentage of the total sample. Census data for Ohio can be used to identify proportional weights for each region.

Racial representation of this sample was also problematic. The population of Ohio is overwhelmingly Caucasian, and the proportion of Caucasian respondents for this survey was only slightly higher than that for the state as a whole. However, the proportions of other racial groups, notably African Americans and Asians, were not representative of the state as a whole. It is likely that the underrepresentation of urban areas in terms of the proportional distribution of respondents by region contributes to this disparity. Within the state of Ohio, the majority of non-Caucasian residents may be found in urban areas. Adoption of a sampling strategy that is more representative of population density is likely to improve racial representation within the sample as well.

Proportional representation by population density can be addressed by determining target quotas for each region based on county and state population without much difficulty or negative impact on participation. Race is a more personally sensitive variable on which to base a quota strategy. Asking the respondent's race early in the survey as a qualifying variable, as was done with gender for this survey, may create the impression that only respondents of a particular race are being sought to answer the survey. If race is used as a qualifying variable for the survey, it is best asked within the context of a set of demographic variables positioned at the beginning rather than at the end of the survey. Another means might be to link zip code and telephone prefix information to urban census tracts for which racial proportions are known.

Another limitation of the data pertains to the rankings for several questions within the survey. Questions 29-34 asked respondents to use a ranking of Very Important, Somewhat Important, or Not At All Important. These response options do not offer a balance of options between what may be considered either positive or negative and, thus, tend to bias the distribution of responses toward the more positive rating of Important, particularly when responses of Very Important and Somewhat Important are combined. Question 35 asked respondents to indicate whether they would be willing to support more, less, or the same amount of tax monies for improvements in math and science education. This ordering of questions places the neutral response ("same") at the end rather than in the center of the continuum. As a result, it was not possible to run correlations for this question, since the possible responses did not follow a linear progression from one extreme to the other.

Conclusions

Overall, respondents believe in the practical value of mathematics and science education. This is evident in their expressed support for changes in the delivery of mathematics and science education, including increased teacher training and hiring, improved classroom technology, and increased linkages between schools and the workplace.

Respondents believe that a quality education in mathematics and science will result in improved job opportunities for students and allow them to contribute to the workplace and the economy. Respondents believe that mathematics and science must help students make sense of the world around them. To that end, respondents identified courses and skills, particularly in mathematics, that are more commonly associated with practical application than with theory as essential for graduation from high school.

Specialized training for teachers in mathematics and science is also an important element of a quality education in mathematics and science. Respondents believe that training and hiring of new teachers should also be accompanied by professional development opportunities for current teachers to enable them to improve their skills in mathematics and science. Accountability is important, however, and respondents also believe that teachers should be periodically tested with respect to their skills and proficiency in mathematics and science.

Accountability for students was a different matter. While most respondents believe that it is important to measure learning better, a large number did not consider state proficiency tests in mathematics and science a fair measure of student learning. This suggests that alternative means for measuring student learning in mathematics and science be explored and developed for use by schools.

Support for changes in the delivery of mathematics and science education is more problematic. While few respondents indicated a preference for spending fewer tax dollars, the remainder were almost evenly divided between preferring to spend at the same level and willing to spend more. This suggests that additional tax levies to support improvements may not be an effective vehicle for funding changes. Thus, while respondents value and recognize the importance of a quality education in mathematics and science, they are not yet ready to fully support additional costs to implement necessary changes in the delivery of mathematics and science education.

Appendices