

Middle School Students' Grade Expectations and Preferred Topics in Science by Gender and Ethnicity

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The author analyzes data from a study of middle grade students regarding their science topic preferences and grade expectations in relation to their ages, genders, and ethnic backgrounds, and she suggests practical and relevant changes in curriculum and teaching strategies that utilizes this data.

Turning Points (Carnegie Council on Adolescent Development, 1989), informed the public that the middle school years are crucial to the future of early adolescents. This period is a trying time for all, but especially for young women. It is a time when students begin to make decisions about what subjects they will take and which ones they will not take. It is also a time when they are forming an identity of self. They are old enough to be able to record and calculate their grades but still young enough to not have a realistic conception of how well they are really doing.

Kahle and Meece (1994) report that science achievement differences by gender are small in elementary school but increase with grade level. Also, achievement differences tend to be greater in the physical science than in the biological science. Okpala and Onocha's (1988) found that there is a significant gender difference in achievement in physics. Several studies also indicate that young women tend to have low self-concepts and

voice that they do not do well in science. In a study of gender and ethnic background, results indicated a relationship between students' selfimages and commonly held notions of what traits are necessary to be a scientist. Both gender and ethnicity were found significant in accounting for variation in how students assessed themselves and their abilities. Males and Whites were more likely to view themselves as intelligent and more likely to demonstrate more interest in science. (MacCorquodale, 1984). However, no studies were found that looked at the grade that students expected to receive in science.

Studies over a wide range of students seems to indicate patterns in students preferences for specific science disciplines. Research about science fair participation suggest that young women tend to enter life science experiments whereas young men enter physical and earth science (Jones, 1991). This supports earlier studies that report that females tend to prefer life science topics and males prefer physical science topics (Lazarowitz & Lazarowitz, 1979; Grant, 1982; Harding, 1985; Wandersee, 1986). This trend seen in the number of women who become physicians as compared to the number of women who become chemists and engineers. Sullivan (1979) found that grade level affects student preferences. Middle grades students favored life science with earth science a close second and physical science as the least favored. Elementary grades students favored earth science/astronomy and life science with physical science/mechanics being the least favored. No studies were found that examined ethnicity and preferred topics in science.

Purpose

The purpose of this study is to examine middle school students' grade expectations and preferred topics of study by

grade level, gender and ethnicity. The specific research questions are:

1. Do middle grades students exhibit different grade expectations according to their grade level, gender, or ethnicity?
2. Do middle grades students exhibit different preferences for life, physical, and earth science by their grade level, gender, or ethnicity?

Method

Data were collected in two suburban school districts during the science period at the end of the academic year. The six schools used were selected because they were very similar in indicators of social status for the children. The sample consisted of 1016 students. Of these, 445 were males and 567 were females; 445 were African-American and 566 were White; 234 in the sixth grade, 408 were in the seventh grade, and 370 were in the eighth grade.

Students were asked as part of the demographic information for a larger study on attitudes toward science to indicate which area of science they liked best. The categories from which they could chose were physical science (heat, light, magnets, matter, energy), earth science (weather, space, earth formation), and life science (plants, animals, ecology). The students were also asked to indicate the grade they expected to get in science, and whether they would continue taking science if they had a choice.

Cross tabulations comparing the actual count to the expected count were run for grade expectation and preferred topic by grade level, gender, and ethnicity. Chi-square tests were also used to analyze the data by grade level, gender, and

ethnicity. An ANOVA was used to examine the expectation of grade in science by grade level, gender, and ethnicity.

Results

Grade expectation

Significant differences ($\alpha = .005$) were seen with students' expectation of their science grade if grade level were examined (Table 2). Sixth grade students under-estimated their likelihood of making an F or D, were accurate for C and A, and over-estimated for a B. Seventh grade students over-estimated for an F and D, were accurate for a C, and under-estimated for a B and A. Eighth grade students were accurate for all grade estimations except for A which they over estimated (Table 1).

Significant differences ($\alpha = .000$) were seen between the males and females when their expectations of grades were examined (Table 4). The males over-estimated that they would get an F, D, or C while the females under-estimated for an F and D and were accurate for a C. Males over-estimated for a B while girls under-estimated and males under-estimated for an A while girls over-estimated for an A (Table 3).

Significant differences ($\alpha = .000$) were seen between African-American and White students as to their expectation for grades (Table 6). African-American students over-estimated the likelihood of getting an F, D, C, and B while the White students under-estimated the likelihood of getting an F, D, C, or B. African-American students under-estimated their grade for an A and White students over-estimated their grade for an A (Table 5).

The ANOVA (Table 7) showed significant differences for expected grade for all three of the main effects at the .05 level. Of the three two-way interactions, gender by grade level was the

only one that was significant (.04). The three-way interaction was not significant.

Preference of area

Significant differences ($\alpha = .000$) were seen with the preferred topic of study if grade level were examined (Table 9). Sixth grade students preferred earth science, seventh grade students preferred life science, and eighth grade students preferred physical science. This was confirmed by the exact opposite results on the question about the area they liked least (Table 8).

Significant differences ($\alpha = .000$) were seen between males and females (Table 11). The males preferred physical science and the females preferred life science. This was confirmed by a reversal on the scores when asked what they liked least (Table 10).

Significant differences ($\alpha = .007$) were seen between African-American and White students (Table 13). African-American students preferred physical science and the White students preferred earth science. Both groups were about equal in their preference to life science (Table 12).

Conclusion/Discussion

The data indicate that as the grade level increases, students were more accurate in their estimation of what grade they were likely to make in science. Sixth graders were very optimistic and expected to do well. In fact, they underestimate their likeliness of making a D or F. Believing that they would not get an F or D may be because these grades are not used in elementary schools. These students may not yet be fully aware

of the possibility of not passing a subject. By the eighth grade, students were much more accurate in their estimations. This ability to predict may be due to maturity or it may be due to having seen a pattern in grades and believing that the pattern will always exist. Both males and African-Americans indicate that they expect to make a low grade in science. Again, this may be due to having begun to see a pattern in their grades. Females over estimated for an A which may indicate that they hoped to do well. Research has indicated that girls tend to want to please which may show in their expectation of good grades. The African-American and White student produced exact opposite grade expectation data. The White students expected to make an A whereas the African-American students did not. The low expectation exhibited by the African-American students was disturbing.

There were no significant findings with the three-way interaction of ethnicity, gender, and grade level. Nor were there any significant findings with any of the two-way interactions. This indicated that the main effects of ethnicity, gender and grade level do not interact to compound the results.

The type of science topics preferred varied for each grade. In the state where the research was conducted, all areas are covered in the 6th grade, life science in the 7th grade, and earth science in the 8th grade. One might suspect that students like what they have just studied but this does not hold true for the 8th grade. They preferred physical science but were taught earth science. This raises some interesting questions about why the 8th grade students preferred a topic that had not been covered in two years. One might question the methods used in teaching earth science to this grade. As has been seen by other researchers, males tend to prefer physical science while females prefer life science. Several researchers have suggested that females prefer

life science because it is often perceived as being more humane. Also, young women are not as often exposed to toys and tools that make them feel comfortable with physical science. It is really interesting to note that when the data were sorted by ethnicity, neither group preferred life science.

Implications

The most significant implication of this study is for curriculum developers. This study indicates that grade level makes a difference in what topics students naturally enjoy. It would seem logical that curriculum developers would use this knowledge in determining what topics would be introduced at each grade level. The preferred topic and what is actually taught at each grade level does not match for the state in which the research was conducted. Perhaps earth science should be introduced in the sixth grade, life science in the seventh grade, and physical science in the eighth grade. This is not the typical sequence that most school districts use now.

There are also implications for teachers. Teachers should be informed of the natural tendency of females to prefer life science and males to prefer physical science. The teachers should be careful not to allow these natural tendencies further exclude females from physical science and males from life science. Instead, the teacher should build on the likes of each gender and consciously work at including each gender in the study of the topic which is least interesting.

Also, teachers should be aware that African-American and White students do not come to science with similar preferences. Knowing these differences should help the teacher plan lessons that address this problem.

References

- Carnegie Council on Adolescent Development. (1989). Turning points: Preparing American youth for the 21st Century. New York: Author.
- Grant, M. (1982). Prized projects. Studies in Design Education, Craft and Technology, 15, 1.
- Harding, J. (1985, April). International panel debate: Gender and science issues. Paper presented at the meeting of the American Association for the Advancement of Science, Ann Arbor, Michigan.
- Jones, G. (1991). Gender differences in science competitions. Science Education, 75, 1591-167.
- Kahle, J. B., & Meece, J. (1994). Research on gender issues in the classroom. In D.L. Gabel (ed.), Handbook of Research on Science Teaching and Learning. (Pp. 542-558). New York: Macmillan.
- Lazarowitz, R. & Lazarowitz, R. H. (1979). Choices and preferences of science subjects by junior high school students in Israel. Journal of Research in Science Teaching, 16(4), 317-323.
- MacCorquodale, P. (1984). Self-image, science and math: Does the image of the "scientist" keep girls and minorities from pursuing science and math? Paper presented at the Annual Meeting of the American Sociological Association, San Antonio, TX.
- Okpala, P. & Onocha, C. (1988). Student factors as correlates of achievement in physics. Physics Education, 23, 361-364.
- Sullivan, R. J. (1979). Students' interests in specific science topics. Science Education, 63(5), 591-598
- Wandersee, J. H. (1986). Plants or animals - which do junior high school students prefer to study? Journal of Research in Science Teaching, 23(5), 415-426.
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Grade Expectation

Table 1. Grade Expectation by grade level.

| Grade Level | | Grade of F | Grade of D | Grade of C | Grade of B | Grade of A | Total |
|-------------|----------------|------------|------------|------------|------------|------------|-------|
| 6 | Count | 5 | 5 | 54 | 105 | 65 | 234 |
| | Expected Count | 9.7 | 15 | 58.7 | 83.8 | 66.8 | 234 |
| 7 | Count | 23 | 32 | 109 | 132 | 111 | 407 |
| | Expected Count | 16.8 | 26 | 102.2 | 145.8 | 116.2 | 407 |
| 8 | Count | 14 | 28 | 92 | 127 | 114 | 375 |
| | Expected Count | 15.5 | 24 | 94.1 | 134.4 | 107 | 375 |
| Total | Count | 42 | 65 | 255 | 364 | 290 | 1016 |
| | Expected Count | 42 | 65 | 255 | 364 | 290 | 1016 |

Table 2. Chi Square Test for Grade Expectation by grade level

| | Value | df | Asymp Sig (2-tailed) |
|------------------------------|---------------------|----|----------------------|
| Pearson Chi-Square | 22.019 ^a | 8 | 0.005 |
| Likelihood Ratio | 24.13 | 8 | 0.002 |
| Linear-by-Linear Association | 1.489 | 1 | 0.222 |
| N of valid cases | 1016 | | |

^a 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.67.

Grade Expectation

Table 3. Grade Expectation by gender.

| Gender | | Grade of F | Grade of D | Grade of C | Grade of B | Grade of A | Total |
|--------|----------------|------------|------------|------------|------------|------------|-------|
| Male | Count | 26 | 45 | 131 | 192 | 120 | 514 |
| | Expected Count | 21.1 | 33.2 | 129.4 | 184.3 | 146 | 514 |
| Female | Count | 16 | 21 | 126 | 174 | 170 | 507 |
| | Expected Count | 20.9 | 32.8 | 127.6 | 181.7 | 144 | 507 |
| Total | Count | 42 | 66 | 257 | 366 | 290 | 1021 |
| | Expected Count | 42 | 66 | 257 | 366 | 290 | 1021 |

Table 4. Chi Square Test for Grade Expectation by gender.

| | Value | df | Asymp Sig (2-tailed) |
|------------------------------|---------------------|----|----------------------|
| Pearson Chi-Square | 22.664 ^a | 4 | 0.000 |
| Likelihood Ratio | 20.933 | 4 | 0.000 |
| Linear-by-Linear Association | 15.152 | 1 | 0.000 |
| N of valid cases | 1021 | | |

^a 0 cells (.0%) have expected count less than 5. The minimum expected count is 20.86.

Grade Expectation

Table 5. Grade Expectation by ethnicity.

| Ethnicity | | Grade of F | Grade of D | Grade of C | Grade of B | Grade of A | Total |
|--------------|----------------|------------|------------|------------|------------|------------|-------|
| African Amer | Count | 25 | 42 | 129 | 171 | 88 | 455 |
| | Expected Count | 18.7 | 29.4 | 114.5 | 163.1 | 129.2 | 455 |
| White | Count | 17 | 24 | 128 | 195 | 202 | 566 |
| | Expected Count | 23.3 | 36.6 | 142.5 | 202.9 | 160.8 | 566 |
| Total | Count | 42 | 66 | 257 | 366 | 290 | 1021 |
| | Expected Count | 42 | 66 | 257 | 366 | 290 | 1021 |

Table 6. Chi Square Test for Grade Expectation by ethnicity.

| | Value | df | Asymp Sig (2-tailed) |
|------------------------------|---------------------|----|----------------------|
| Pearson Chi-Square | 41.244 ^a | 4 | 0.000 |
| Likelihood Ratio | 42.038 | 4 | 0.000 |
| Linear-by-Linear Association | 35.300 | 1 | 0.000 |
| N of valid cases | 1021 | | |

^a 0 cells (.0%) have expected count less than 5. The minimum expected count is 18.72.

Grade Expectation

Table 7. Anova:

Grade Expectation by Ethnicity, Gender and Grade level.

| | | | Sum of Squares | df | Mean Square | F | Sig | |
|-------|-------------------|------------|----------------|------|-------------|--------|------|--|
| Grade | Main Effects | (Combined) | 65.489 | 4 | 16.372 | 15.551 | .000 | |
| | | EthnicGr | 39.411 | 1 | 39.411 | 37.433 | .000 | |
| | | Gender | 18.654 | 1 | 18.654 | 17.718 | .000 | |
| | | Glevel | 7.424 | 2 | 3.712 | 3.526 | .030 | |
| | 2-way interaction | (Combined) | 11.578 | 5 | 2.316 | 2.199 | .052 | |
| | | EthnicGr | | | | | | |
| | | *Gender | 8.198E-02 | 1 | 8.198E-02 | .078 | .780 | |
| | | EthnicGr | | | | | | |
| | | * Glevel | 4.469 | 2 | 2.234 | 2.122 | .120 | |
| | | Gender | | | | | | |
| | | * Glevel | 8.810 | 2 | 3.405 | 3.234 | .040 | |
| | 3-way interaction | EthnicGr | | | | | | |
| | | * Gender | .818 | 2 | .409 | .389 | .678 | |
| | | * Glevel | | | | | | |
| | Model | | 77.884 | 11 | 7.08 | 6.725 | .000 | |
| | Residual | | 1057.044 | 1004 | 1.053 | | | |
| | Total | | 1134.928 | 1015 | 1.118 | | | |

Preferred Topic

Table 8. Preferred Topic by grade level.

| Grade level | | Physical Science | Earth Science | Life Science | Total |
|-------------|----------------|------------------|---------------|--------------|-------|
| 6 | Count | 43 | 79 | 112 | 234 |
| | Expected Count | 57.6 | 63.1 | 113.3 | 234 |
| 7 | Count | 101 | 87 | 220 | 408 |
| | Expected Count | 100.4 | 110.1 | 197.5 | 408 |
| 8 | Count | 105 | 107 | 158 | 370 |
| | Expected Count | 91 | 99.8 | 179.2 | 370 |
| Total | Count | 249 | 273 | 490 | 1012 |
| | Expected Count | 249 | 273 | 490 | 1012 |

Table 9. Chi Square Test of Preferred Topic by grade level.

| | Value | df | Asymp Sig (2-tailed) |
|------------------------------|---------------------|----|----------------------|
| Pearson Chi-Square | 20.241 ^a | 4 | .000 |
| Likelihood Ratio | 20.578 | 4 | .000 |
| Linear-by-Linear Association | 5.929 | 1 | .015 |
| N of valid cases | 1012 | | |

^a 0 cells (.0%) have expected count less than 5. The minimum expected count is 57.58

Preferred Topic

Table 10. Preferred Topic by gender.

| Gender | | Physical Science | Earth Science | Life Science | Total |
|--------|----------------|------------------|---------------|--------------|-------|
| Male | Count | 166 | 132 | 209 | 507 |
| | Expected Count | 124.8 | 137.2 | 245 | 507 |
| Female | Count | 84 | 143 | 282 | 509 |
| | Expected Count | 125.2 | 137.8 | 246 | 509 |
| Total | Count | 250 | 275 | 491 | 1016 |
| | Expected Count | 250 | 275 | 491 | 1016 |

Table 11. Chi Square Test of Preferred Topic by gender.

| | Value | df | Asymp Sig (2-tailed) |
|------------------------------|---------------------|----|----------------------|
| Pearson Chi-Square | 38.186 ^a | 2 | .000 |
| Likelihood Ratio | 38.730 | 2 | .000 |
| Linear-by-Linear Association | 34.884 | 1 | .000 |
| N of valid cases | 1016 | | |

^a 0 cells (.0%) have expected count less than 5. The minimum expected count is 124.75.

Preferred Topic

Table 12. Preferred Topic by ethnicity.

| Ethnic Group | | Physical Science | Earth Science | Life Science | Total |
|--------------|----------------|------------------|---------------|--------------|-------|
| African | Count | 128 | 103 | 218 | 449 |
| Amer | Expected Count | 110.5 | 121.5 | 217 | 449 |
| White | Count | 122 | 172 | 273 | 567 |
| | Expected Count | 139.5 | 153.5 | 274 | 567 |
| Total | Count | 250 | 275 | 491 | 1016 |
| | Expected Count | 250 | 275 | 491 | 1016 |

Table 13. Chi Square Test of Preferred Topic by ethnicity.

| | Value | df | Asymp Sig (2-tailed) |
|------------------------------|---------------------|----|----------------------|
| Pearson Chi-Square | 10.048 ^a | 2 | .007 |
| Likelihood Ratio | 10.081 | 2 | .006 |
| Linear-by-Linear Association | 1.614 | 1 | .204 |
| N of valid cases | 1016 | | |

^a 0 cells (.0%) have expected count less than 5. The minimum expected count is 110.48.