A Comparison of the Academic Achievement of Home School and Public School Students[1]

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ABSTRACT

This study added to existing data on home school effectiveness by comparing the academic achievement of 66 home school students with 66 of their grade-level peers in traditional public schools. The two groups of students were matched on gender, race, and grade level and were administered the Woodcock-Johnson Psychoeducational Battery III. No significant difference in overall academic achievement was found between the groups. Both home school and public school students had average or above average scores in reading, math, written language, and broad knowledge (science, social studies, and humanities). The results further revealed a downward trend in math, reading and broad knowledge scores with increasing grade level. This trend suggests that home school and public school students experience a "developmental mismatch" between the changes that occur in adolescence and their school/home experiences, resulting in lower motivation, confidence, and academic performance.

1.   Introduction

A growing number of families in the United States are educating their children at home rather than in a traditional school setting. In 2009, approximately 1.5 million American parents were teaching their children at home, up from the 850,000 students the federal government estimated were home schooled in 1999 (Ray, 2009), although the growth rate has declined over the last two decades. The growth rate in the late 60's was estimated to be 7% to 15% per year (Home School Legal Defense Association, 1997; Ray, 1997) but more recent estimates are 2% to 8% per annum over the past few years

(Bielick, 2008). Once discouraged in many states, it is now legal in every state, although the laws and standards that regulate it vary. Since a Supreme Court decision in 1985 that ruled a home school could operate under the existing private school law, most states recognize home education as an alternative for complying with compulsory school attendance requirements (Furst, 1994).

A review of the literature indicates parents home school their children for varied reasons. Some reasons can be classified as familial, such as teaching specific values, providing a Christian education, controlling social interactions, developing close family ties, and maintaining a high level of academics (Ray, 1990; Ray, 1997). Other reasons pertain to dissatisfaction with the public schools, including inadequate academic standards, the lack of a quality curriculum and character education, teaching methods, and control of student behavior (Cizek, 1988; Gray, 1993; Murray, 1996; Wilhelm & Firmin, 2009).

However, some of the practices and procedures that pertain to the academic effectiveness of home-school education are controversial. Typical home education practices use child-centered curricular approaches involving private, individualized instruction (Hadderman, 2000), smaller time periods of highly focused academic learning time and an environment free from distractions (Murray, 1996). Some follow the philosophy of John Holt (Welner & Welner, 1999) and allow the child's natural curiosities to define the content and pace of education, rejecting set curricula and testing. State requirements for curriculum, assessment, record keeping, educational qualifications for homeschooling parents, protections for at-risk students, and extracurricular activities are often inadequate or lack enforcement (Coalition for Responsible Home Education, 2017). Moreover, many states do not require annual submission of curriculum plans or test scores and none require the home-schooling parent to be a certified teacher. (Lines, 2011). For these reasons, the National Education Association called for more vigorous regulation of home school practices. The practice of home schooling is opposed by the National Parent-Teacher Association as well as the National Association of Elementary School Principals, which endorses the philosophy that the most effective educational models are carried out in more formal settings (Lines, 2011).

A small body of research is available on the academic effectiveness of home school education. Most studies indicate that the students educated at home perform as well as or better than their peers in conventional schools on standardized achievement tests (Boulter & Macaluso, 1994; Eaton, 1993; Ray, 1988; 1997; Rudner, 1998). A nationwide study reported average percentile scores for home school students tested with the nationally normed Iowa Test of Basic Skills: median test scores across grade level were in the 87th percentile in reading, the 80th percentile in language and the 82nd percentile in math (Ray, 1997). In comparison, the nationwide median percentile of students educated in traditional (public and private) schools was at the 50th percentile in reading, language, and math. A large study of home school students in the southeast region by Rudner (1998) reported median scores across grade level and subject area that ranged from the 70th to 80th percentile.

At the state level, home-educated students from grades K through 8 in the state of Washington consistently scored above the national average on the Stanford Achievement Test in reading, language, math and science. The median score was at approximately the 67th percentile on national norms (Ray, 1992). A similar study of 4th and 7th grade students in Arkansas reported that the home schooled students scored higher than public school students in all major content areas (Calvery, Bell, & Vaupel, 1992).

Some studies, however, reported academic achievement scores that were not above the average of their traditionally educated peers. A study of home schooling in Alabama found that home educated students at the 1st and 4th grade level scored below the national average in math (Rakestraw, 1988). In Arkansas, 10th grade students scored significantly above public school means for their grade level in reading, mathematics, science and social studies, but scored significantly lower in language (Calvery, Bell, & Vaupel, 1992).

Controlled empirical studies published in the 1990's explored possible gender or grade-level differences through high school (Cizek & Ray, 1995; Ray, 1997) or compared the test scores of home schooled students with other students in public or private schools that have similar demographic characteristics (Rudner, 1998; Welner & Welner, 1999), but no studies published in peer-reviewed journals since 2000 have been found that made such comparisons.

More recent studies compared the abilities of home schooled versus traditionally educated students when they became young adults. Riley (2015) found young adults who were home-schooled had significantly higher levels of autonomy and competence satisfaction than their traditionally educated peers, but there was no difference in the level of relatedness satisfaction. Wasley (2007) reported that studies measuring home-schoolers' academic and social performance throughout their years in college found little difference between their performance and that of their traditionally educated peers.

The procedures used in the previous research raise several methodological issues. First, most of the previous research measuring the academic effectiveness of home school education typically described academic achievement by reporting mean percentiles for a few selected age or grade levels. There are a limited number of controlled empirical studies that explored possible gender or grade-level differences through high school (Cizek & Ray, 1995; Ray, 1997).

A second issue concerns the appropriateness of standardized group achievement tests such as the California Achievement Test, the Stanford Achievement Test and the Iowa Test of Basic Skills (Lines, 1987; Rudner, 1998; Wright, 1988) to measure home school effectiveness. The achievement that is most appropriate for use is the one that is the best match with the instructional objectives of the particular school "system" (Aiken, 2000). Although reviews of the group standardization sample demonstrate adequate reliability and validity coefficients for screening academic performance (Ebel, 1978; Wright, 1988), the content and administration procedures of the group achievement tests may not be a valid assessment of students educated exclusively in an individualized curriculum (Cizek, 1988; Jenkins & Pany, 1978; Wright, 1988). These measures were designed to assess and compare the achievement of large groups (Cizek, 1991; Cizek & Ray, 1995). Studies are needed using individualized assessments of academic achievement to evaluate the overall quality of home education (Mayberry, Knowles, Ray, & Marlow, 1995).

Third, the research using the tests mentioned above reported results in the form of percentiles, sometimes comparing the median percentiles of the home school students with the median (50th) percentile from the nationwide standardization sample typically made up of public and private school students (Conoley & Kramer, 1993). Ordinal-level measurements such as percentiles, however, are not considered suitable for making complex interpretations of test scores or calculating differences between scores (Salvia & Ysseldyke, 1995). Because the distances between percentiles are not equal, the percentiles cannot be directly averaged. Thus, it is not possible to average one person's percentile ranks on two or more tests, or average the percentiles of a group of people who took the same test. Standard scores are more appropriate for statistical analysis and research because they are equal-interval scales and based on a standard deviation from the mean. Group comparisons are possible and the scores can be averaged (Lyman, 1991; Woodcock, McGrew, & Mather, 2001).

The purpose of the present research was to add to existing data on home school effectiveness by comparing the academic achievement of 66 home school students with 66 of their grade-level peers in traditional public schools. The two groups of students were matched on gender, race, grade level, and type of school (home or public), and administered a standardized achievement test assessing core content areas. No significant difference in overall academic achievement was found between the groups. The results further revealed a downward trend in math, reading and broad knowledge scores with increasing grade level. The findings from this study will aid policy decisions regarding regulation of home school education.

Following this review of the literature is a description of the methods, participants, procedures, data analysis and results. The paper concludes with an interpretation of the findings and a discussion of limitations, future studies, and policy implications.

2.   Method

2.1   Participants

A sample of 132 students, 66 home school students and 66 public school students, from the southwest region of North Carolina were administered a standardized academic assessment battery. The home school students were selected from consenting parents who had requested "end-of-grade" testing for their child to comply with state law that mandates home-schooled students be tested annually with a standardized achievement test. To identify the comparison group of public school students, the researchers mailed letters with information about the study and a consent form to all the regular education students enrolled in the 3rd and 4th grades at two elementary schools; the 6th and 7th grades at two middle schools, and the 9th and 10th grade students enrolled in English I and English II at two high schools. None of the students had been identified with mental retardation or with a specific learning disability. Since all of the families in the home school sample were Caucasian, only Caucasian public school families received letters. Researchers sampled from among the students with parental consent. The home school and public school samples were then matched by gender (34 male, 32 female) and grade (21 elementary, 21 middle school, and 24 high school).

2.2   Measures and Procedure

Academic achievement was measured with the Woodcock-Johnson III Tests of Achievement (WJ III), an individually administered, norm-referenced assessment commonly used to measure the academic development of individuals from preschool through adulthood (Woodcock, McGrew, & Mather, 2001). The WJ III Standard Battery consists of nine tests, including two reading tests (Letter-Word Identification and Passage Comprehension), two mathematics tests (Calculation and Applied Problems), two writing tests (Dictation and Writing Samples), and three tests of specific content areas (Science, Social Studies, and Humanities). The Humanities test measures knowledge of music, art and literature. In addition to the scores for each of the individual tests, four cluster scores are derived through analysis of certain combinations of the nine tests. Broad Reading measures reading achievement, Broad Mathematics measures math achievement, Broad Written Language measures both production of single-word responses and production of sentences embedded in context, and Broad Knowledge measures acquisition of general information in the three content areas listed above. The WJ III is considered an appropriate measure of academic aptitude and achievement for children age 2 and over, and is accepted as a research tool to measure program effectiveness and developmental change in individual abilities over wide spans of time (Wodrich, 1997; Costenbader & Perry, 1990; Woodcock, McGrew, & Mather, 2001). Reviews of the WJ-R report adequate internal consistency coefficients for all age groups exceeding .90 for the achievement clusters and ranging from the .80s to 90s for the individual subtests (Cummings, 1994; Ebel, 1978; Salvia & Yesseldyke, 1991).

Three researchers administered the WJ III to the public school students during the final months of the academic year (April and May) and tested the home school students during May and June of the same year. The researchers tested each public school student individually in a room set aside for testing at each school site. Parents brought the home school students to the college campus and a researcher tested each student in a designated testing room. All participants were assured complete anonymity and told they had the right to refuse or discontinue testing at any time.

3.   Results

Student performance on each WJ III subtest and cluster was reported in standard scores (mean = 100, standard deviation = 15). Individual student standard scores for each of the four WJ III clusters (Broad Reading, Broad Math, Broad Written Language, Broad Knowledge) were then averaged and mean standard scores were calculated for each type of schooling at the elementary, middle school and high school levels. To facilitate comparison of these results with the percentiles reported in previous research, the standard score and the corresponding percentile are reported. Descriptive statistics for the home school students and the public school students are displayed in Table 1 and Table 2 respectively.

Table 1: Mean standard scores for home school students by grade level

WJ III Clusters				
Grade Level	Broad Reading	Broad Math	Broad Written Language	Broad Knowledge
Elementary (n = 21)				
M	118	122	101	110
SD	19.57	20.46	15.71	15.32
PR	89	93	52	75
Middle School (n = 21)				
M	109	112	102	103
SD	15.56	29.29	23.72	15.15
PR	73	79	54	57
High School (n = 24)				
M	111	106	106	104
SD	20.56	23.97	27.32	19.44
PR	76	65	65	61
Total (n = 66)				
M	113	113	103	105
SD	18.90	25.39	22.74	16.88
PR	80	80	57	63

Note. M = mean, SD = standard deviation, PR = percentile rank

Table 2: Mean standard scores for public school students by grade level

WJ III Clusters				
Grade Level	Broad Reading	Broad Math	Broad Written Language	Broad Knowledge
Elementary (n = 21)				
M	114	134	102	114
SD	17.08	20.80	14.49	12.70
PR	83	99	54	83
Middle School (n = 21)				
M	107	105	91	102
SD	14.73	15.81	23.58	10.27
PR	67	63	27	54
High School (n = 24)				
M	115	106	107	105
SD	14.12	12.33	14.89	10.69
PR	84	65	67	63
Total (n = 66)				
M	112	115	101	105
SD	15.53	20.96	18.93	12.10
PR	79	84	52	67

Note. M = mean, SD = standard deviation, PR = percentile rank

3.1   Home school and public school comparison

The prediction of differences between type of schooling (home or public school), gender, and grade level (elementary, middle school or high school) was tested in a 2 x 2 x 3 mixed design using MANOVA procedures. No significant main effect was observed for type of schooling, $F(1, 120) = .32$, $p < .46$, ns. A main effect of gender emerged, however, in which male students scored significantly higher than female students in Broad Math, $F(1, 120) = 7.61$, $p < .01$, and Broad Knowledge, $F(1, 120) = 8.29$, $p < .01$. A second main effect was observed for grade level, $F(2, 120) = 4.83$, $p < .01$. Tukey HSD tests (alpha = .05) revealed that the mean standard scores in Broad Math (128) for the elementary students were significantly higher ($p < .001$) than the middle school (108) and high school students (106). There were no significant interactions, all Fs < .1, ns.

Because the academic achievement scores of the home school students were not statistically different from the scores of the public school students, the two groups were combined and separate one-way ANOVAs were calculated for Broad Reading, Broad Math, Broad Written Language, and Broad Knowledge. Results showed significantly higher ($p < .01$) Broad Knowledge mean scores for elementary school students (112) than middle school students (103). The Broad Knowledge mean scores for the elementary school students were also significantly higher ($p < .03$) than the high school students (104). A trend that approached significance was also observed in reading and written language ability as grade level increased. The mean standard scores in reading at the elementary level (116) exceeded the middle school level (108; $p < .08$). Although the mean written language standard scores of the elementary students (102) did not differ from the middle school scores (97), an increase in written language standard scores was observed at the high school level (107; $p < .08$). The other interactions were not significant, all Fs < .1, ns.

3.2   Academic achievement

Since the home school and public school groups did not differ significantly, the mean standard scores for each cluster were examined to determine the overall academic achievement of each group. The mean standard scores/percentiles for the home school students were 113 for Broad Reading, 113 for Broad Math, 103 for Broad Written Language and 105 for Broad Knowledge. The mean standard scores/percentiles for the public school students were 112 for Broad Reading, 115 for Broad Math, 101 for Broad Written Language and 107 for Broad Knowledge. Thus, both groups of home school students and public school students scored at or above the mean standard score of 100 on each of the four clusters.

4.   Discussion

In general, the academic achievement scores of the home school students in this study did not differ significantly from the scores of the public school students. However, both groups demonstrated a downward trend in achievement scores with increasing grade level. The middle school students scored significantly lower that the elementary students in Broad Math and Broad Knowledge.

4.1   Home school and public school comparison

Home school and public school students overall performed at or above average in Broad Reading, Broad Math, Written Language and Broad Knowledge. This finding is consistent with the results of previous nationwide and statewide studies that assessed the effectiveness of home school education by using the general nationwide population of public and nonpublic school students as the "norm" or comparison group (Ray, 1992, 1997). The results of this and previous studies suggest that home school education is as effective as traditional education in all the major subjects.

Contrary to previous findings, however, no significant differences were observed between the academic performance of home school students and public school students on any of the four

measured content areas. Moreover, the overall achievement of elementary, middle school and high school home school students was similar to that of the corresponding grade levels of public school students, and the home school male and female students performed as well as the public school male and female students.

These findings suggest that the home school educational environment is as effective as the traditional public school model for both males and females at all grade levels.

One possible reason for the apparent contradiction with earlier research may be that this study used different sampling and testing procedures. First, selecting public school students who were demographically matched with the home school students provided a more comparable sample than the state-wide or nation-wide samples of public school students used for comparison in previous studies (Welner & Welner, 1999). Second, the individualized achievement test provided greater efficiency during testing and a more sensitive measure of student strengths and weaknesses than a group achievement test (Aiken, 2000). Third, since averaging percentiles is statistically inappropriate, averaging standard scores provided a more accurate index of achievement and may have greatly reduced the differences in achievement between the two types of schooling.

4.2   Gender comparison

The scores of male and female students differed significantly in Broad Math and Broad Knowledge. The performance of the male students was fairly consistent but the achievement scores of the female students had dropped by middle school, with minimal improvement in high school. Consistent with the literature, male students maintained a mild to moderate edge over female students in math and spatial abilities at least until high school (Linn & Hyde, 1989).

4.3   Academic achievement

The performance of home school and public school students on specific content areas declined with increasing grade level. When groups were combined and the achievement in specific content areas at different grade levels was analyzed across the two types of schooling, downward trends were observed in math, broad knowledge and reading between the elementary and middle school grades. The one positive trend was the improvement in writing skills between the middle school and high school.

Consistent with the findings of past investigations involving public school students (Eccles, et al. 1993), therefore, a drop in academic performance early in the middle school years was observed, compared to their performance in elementary school. One possible explanation, based on developmental theories of motivation (Anderman & Midgley, 1997), is a "developmental mismatch," (Eccles & Midgley, 1996) that occurs between the needs of the developing adolescents and their experiences at school and at home. As students transition from elementary to middle school, they become less interested in school and less confident about their academic abilities. This decreased motivation and confidence contribute to lower academic performance (Eccles & Midgley, 1996). The trends in this study suggest that, despite the child-centered, interest-based, individualized instructional model that characterizes home school education, home school students are just as vulnerable to a "developmental mismatch" as their public educated peers. As the home school students progress from the elementary grades to the middle school level, the physiological, psychological and social needs that occur at adolescence may clash with their home school experiences, resulting in lower motivation, confidence and academic achievement.

The grade level and gender related observations reported in this study are typically lacking in the findings of earlier studies (Ray, 1997; Rudner, 1998). A possible explanation may be that most previous research averaged the mean percentiles across grade, gender, and/or subject areas. This statistical

procedure may have prevented the observation of any grade level, gender or subject area differences in performance.

This research reaffirms the effectiveness of home school education and advances the knowledge of the effects of home schooling with increasing grade level. The findings are limited, however, due to the small, ethnically and culturally homogeneous sample. Possibilities for additional research include sampling the population of home school families who are non-Caucasian, and including families in the home school sample who did not specifically request standardized testing for their children. Additional studies might also examine whether the performance of the home school students is related to the effectiveness of the individualized, self-paced instructional model and/or to the motivation of the home educators. A longitudinal study assessing a more demographically diverse sample of home school and public school students would be useful to track academic achievement across time.

The findings from this study also support the need for more effective homeschool policy and oversight of homeschool education to provide basic protections for students. Without federal guidelines, individual states must govern homeschooling but policies vary widely from state to state. Uniform, statewide policies are needed requiring a standards-based curriculum and instruction by a qualified teacher. Policies must also require appropriate annual assessments to assure students are making adequate academic progress in core subjects. Finally, states must provide oversight of these requirements through examination of assessment scores and site visits to homeschools that are non-compliant or low performing.

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