Education Journal《教育學報》, *Vol. 31, No. 2, 2003 & Vol. 32, No. 1, 2004*

What Can We Say about the Quality and Equality of Educational Systems from the First Cycle of the PISA?

J. DOUGLAS WILLMS
Canadian Research Institute for Social Policy, University of New Brunswick

How can we help all children learn what they need to know to prepare for the future? In every country/region that is participating in the OECD Programme for International Student Assessment (PISA), a study of the literacy skills of 15-year-old youth, there is a huge gap between the best and worst performing students. This shows the need for parents, educators, administrators, and policy-makers to direct their efforts toward leveling the playing field. This article examines variation among countries/regions and schools in their reading performance, with particular attention to the remarkable success of students in Hong Kong. It also suggests ways to narrow the gap and raise the learning bar for all.

In 2002, about 5,000 15-year-old students in Hong Kong participated in the Programme for International Student Assessment (PISA), a survey of their skills in three literacy domains: reading, mathematics, and science. The Organisation for Economic Co-operation and Development (OECD) conducted the first survey in 2000 to assess young adults' ability to use their knowledge and skills to meet the challenges facing them as they approach the end of compulsory schooling (OECD, 2001). The survey will be repeated every three years.

Hong Kong students fared exceptionally well in the first PISA survey, which focused mainly on reading performance. It ranked sixth among 42 participating countries/regions. It was virtually tied with New Zealand, Australia, and Ireland, and lagged behind Canada by 9 points and Finland, the highest scoring country, by 21 points. In mathematics,

Hong Kong was in the first place, and in science, it ranked third, just slightly behind Korea and Japan (OECD & UNESCO, 2003). Hong Kong is clearly among the group of ten top-scoring countries/regions in the world, along with Australia, Canada, Finland, Japan, Korea, Ireland, New Zealand, Sweden, and the United Kingdom.

PISA assesses students in several ways, including a series of written tasks that measure reading, mathematical, and scientific literacy, and a questionnaire that asks about their family background, their experiences at school, and their attitudes toward learning. The survey was developed by a team of international experts, with input from teachers and employers about the kinds of skills students need when they enter the labor market or pursue further education (OECD, 2001).

PISA 2003 focused on mathematics and problem-solving, and in 2006 it will emphasize science. Mathematics, problem-solving, and science skills are especially important in a knowledge-based economy. The demand for youth who are highly skilled in these domains continues to increase. Moreover, there is broad agreement among researchers and the policy community that the skills measured in PISA are critical to employment and to sustained growth in the new economy (OECD & Statistics Canada, 2000). These skills are also precursors to the long-term health and well-being of our youth (Grossman & Kaestner, 1997; Ross & Wu, 1995).

Given the success of Hong Kong students in all three domains of literacy, parents, educators, administrators, and policy-makers might reasonably ask: what next? Is it simply a question of aiming to be number one in all three domains? The Canadian government, partially in response to the PISA findings, set out an Innovation Strategy to build a skilled workforce and an innovative economy. Two of the milestones of the strategy are that Canada is to become one of the world's top three countries in mathematics, science, and reading achievement; and for all students who graduate from high school, it is to achieve a level of literacy sufficient to participate in the knowledge-based economy (Government of Canada, 2001).

In most countries/regions, PISA scores fluctuate by about plus or minus 10 points, simply due to measurement and sampling error (OECD, 2001). Given that most countries/regions scoring in the top group of ten have scores that are quite close to one another, it is likely that the 2003 ranking will fluctuate somewhat simply due to the vagaries of statistical sampling. Thus, I maintain that scoring in top place, or

second, third, fourth or fifth, is relatively less important than ensuring that all students have the necessary skills to participate in the knowledge-based economy. Like Canada, Hong Kong has several students who score at the lowest two levels on the five-level PISA literacy scale. The chances for these students to participate in the new economy are greatly diminished. Moreover, other research suggests that youth with low literacy skills are more prone to dropping out of school before graduation, being unemployed, experiencing long periods of depression or other mental illnesses, and participating in delinquent activities (e.g., see Willms, 2003a). Thus, a key question facing families, educators, employers, and policy-makers is: "How can we raise and level the learning bar?"

The Learning Bar

The term "learning bar" is used here as a metaphor for what social scientists refer to as a socio-economic gradient (Adler et al., 1994; Willms, 2003b). In education, a socio-economic gradient depicts the relationship between student performance and the socio-economic status of the student's family. PISA uses a composite measure of students' economic, social, and cultural background derived from their descriptions of their parents' education and occupation, and the material and cultural possessions in their home. The measure is scaled to have an average of zero for all OECD students. Students with a score below minus 1 on this scale fall in the bottom one-sixth of OECD students for socio-economic status, while those with a score above 1 are in the top one-sixth.

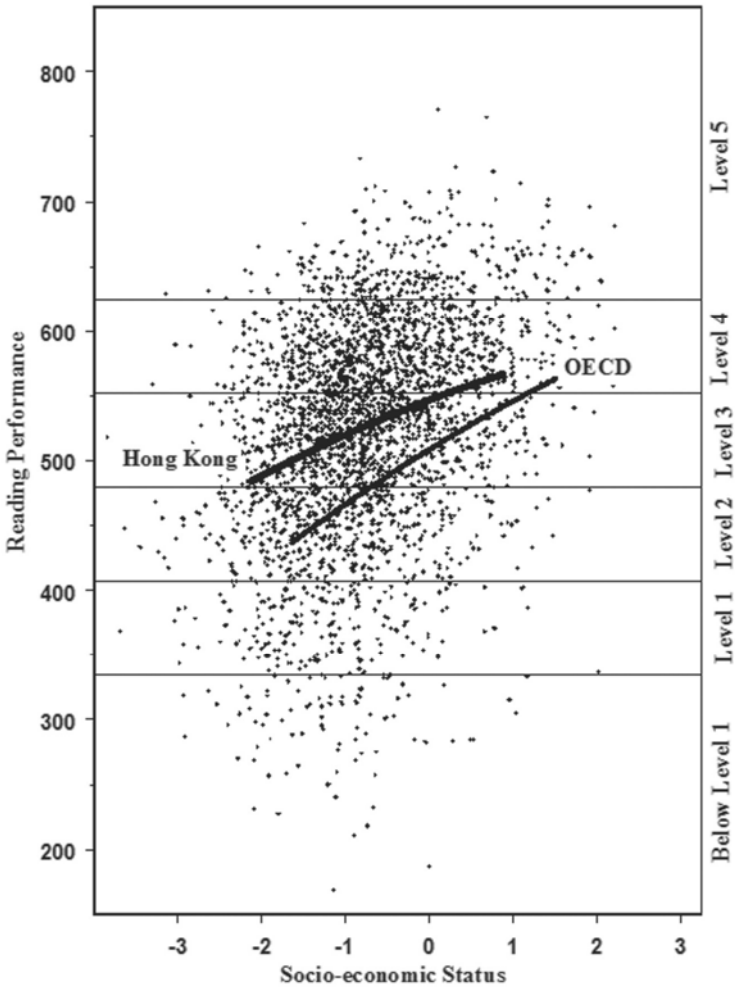
Figure 1 shows the socio-economic gradient for Hong Kong and for all OECD countries combined. The small black dots are students' scores on the PISA reading test plotted against their family's socio-economic status, for a representative sample of Hong Kong students.

The figure shows that on average Hong Kong students scored above those in other OECD countries. Also, Hong Kong's gradient is more gradual, indicating less inequality associated with students' socio-economic status.

Hong Kong's results show a wide range of reading scores at all levels of socio-economic status. What is particularly worrisome is that many students scored at Level 2 or lower (Reading achievement is

divided into five levels, with Level 5 being a very high level of literacy. Students who perform below Level 1 may have some literacy skills but find it very difficult to use reading as a tool to advance their knowledge in other areas).

Figure 1. Socio-economic Gradient for Hong Kong



Source: OECD (2000).

Five Strategies for Raising and Leveling the Bar

PISA is not simply an assessment of what youth learn in high school, or even during their entire school career. It is an indication of the skill development and learning that occur both in and out of school, right from birth until age 15. Clearly then, a country/region's results on PISA depend on the quality of care and stimulation given to children during infancy and the pre-school years, and on children's opportunities to learn — in school, at home, and in the community — during the elementary- and secondary-school years.

Therefore, raising Hong Kong's learning bar cannot be achieved simply through education reforms such as changing the curriculum, reducing class size, or putting more computers in the classroom. It requires a more comprehensive approach, involving families, teachers, community leaders, employers, and the broad policy community, aimed at *enabling families* through strategic investments in human capital. These might include, for example, efforts to improve the health and care of newborns, increase access to quality early education programs, increase students' engagement at school, and reduce barriers to life-long learning. It may also require a more concerted effort, particularly by educational leaders, to increase social inclusion through policies that ensure equality of opportunities of marginalized children and youth. Finally, it will require government to continue making strategic investments in program evaluation, monitoring, and research.

Researchers in Canada are embarking on a four-year research program, funded by the Social Sciences and Humanities Research Council, aimed at examining strategies to "raise and level the bar" in children's cognitive, behavioral, and health outcomes. The research is being carried out by 21 "new investigators" from across Canada from diverse academic disciplines, including economics, education, epidemiology, health care, nursing, psychology, and sociology. These scholars work in small teams, mentored by senior researchers who are also from diverse academic backgrounds. The aims of the research program are to:

- establish a sustainable network of 20–25 new scholars who are dedicated to scholarship in human development;
- build a unified and comprehensive monitoring system for tracking the developmental outcomes of Canadian children and youth;

- build a research and training infrastructure aimed at supporting new investigators in the analysis of data from large, complex surveys, such as PISA and the National Longitudinal Survey of Children and Youth (NLSCY);
- contribute to the research knowledge pertaining to each of five strategies that aim at raising and leveling the bar;
- establish an effective knowledge transfer strategy which includes the development of clear, credible, and compelling materials for dissemination, and a receptor capacity within several key organizations serving children and youth.

The five strategies for raising and leveling the bar are relevant not only to the outcomes of Canadian youth, but also to youth in Hong Kong and elsewhere. These are discussed below.

Safeguard Infants' Healthy Development

The brain development of infants from conception to age one is much more rapid and extensive than neuroscientists believed ten years ago (Carnegie Corporation of New York, 1994). Recent research has also shown that brain development is heavily influenced by an infant's environment. Children's learning, health, and behavior appear to be the result of several neurobiological processes, including the pruning of synapses or "sculpting" of the brain, changes in neurotransmitters, and gene activation (Shore, 1997). Scientists now believe that infants receive signals from their environment that alter and become "embedded" in certain physiological and neurobiological systems, thereby affecting later cognitive development, behavior, and health (Barr, Beek, & Calinoiu, 1999).

These recent findings are substantiated by the work of social scientists who have shown that population interventions such as home visitation programs, combined with parent training and support, have long-lasting effects on a wide range of children's outcomes (Olds, Eckenrode, et al., 1997; Olds, Henderson, et al., 1998; Osborn & Milbank, 1987; Wasik, Ramey, Bryant, & Sparling, 1990). Taken together, such findings provide a powerful argument that care and stimulation during the early years are critical to establishing a foundation for learning, positive behavior, and health over the life cycle. If we are to raise and level the learning bar, perhaps the most important

strategy is to ensure that families have the support they need to provide the best possible care for their children (Willms, 2002).

Strengthen Early Childhood Education

Most children say their first few words at about 12 months of age. It is an exciting time, as this is soon followed with more words, and then an exponential growth in vocabulary. However, the pace of development differs among children, and depends on their environment. Huttenlocher, Haigth, Bryk, Seltzer, and Lyons (1991) conducted detailed studies of children's vocabulary development from 12 to 26 months. Their work demonstrates the importance of understanding children's *growth trajectories*. A multilevel analysis of their data revealed that children varied significantly in their rates of vocabulary growth, and that about 20% of this variation was associated with the quantity of mothers' speech. Also, the frequency with which mothers used particular words was strongly related to the age at which children acquired those words. Their findings were supported by the findings of the landmark study by Hart and Risley (1995), who recorded the words spoken by parents and their children for one full hour every month over a period of two-and-a-half years. They found that children in professional families were typically exposed to over 2,000 words per hour, while those in welfare families were exposed to just over 600 words per hour. Their analyses show the cumulative effects of these differences in early childhood experience on later outcomes, and led them to conclude: "the most important aspect to evaluate in child care settings for very young children is the amount of talking actually going on, moment by moment, between children and their caregivers" (p. xxi).

This research has important implications for social policy aimed at providing quality care and stimulation during the early years. It provides strong evidence of the importance of both the *quantity* and *quality* of parental speech. Research on the quality of early child care also emphasizes the importance of low child-to-adult ratios, highly educated staff with specialized training, and good facilities and equipment to provide stimulating activities (Arnett, 1989; Howes, Phillips, & Whitebrook, 1992; Lazar, Darlington, Murray, Royce, & Snipper, 1982; Phillips, 1987). It is these dimensions of quality that distinguish "day-cares," with a custodial function, from "early childhood development centers", which emphasize growth in children's development.

Studies in several countries demonstrate that the quality of care offered in early childhood development centers affects children's linguistic, cognitive, and social competence (Andersson, 1989, 1992; Burchinal, Roberts, Nabors, & Bryant, 1996; Goelman & Pence, 1987; McCartney, 1984; Peterson & Peterson, 1986). The Hashemite Kingdom of Jordan has embarked on a monitoring program that measures children's development upon school entry in five areas — awareness of self and environment, language development, cognitive development, behavior, and health — using an instrument called the Early Years Evaluation (Willms & Beswick, 2003). Their plan is to assess changes in these outcomes as communities increase early childhood provision. Dominican Republic is poised to follow this approach, with a comprehensive plan to improve access to quality early childhood programs.

It would be difficult to estimate what effect the universal provision of early childhood education might have on the long-run learning and health outcomes of children and youth in Hong Kong. However, we do know that environments that expose children to a quality and quantity of language and the opportunity to play and engage in stimulating activities have strong, measurable effects on children's cognitive and language development. And we also know that skills in these domains are highly predictive of future academic success.

Create a Family-enabling Society

Canada's NLSCY is a large, ongoing survey following children from birth to adulthood. Conducted by Human Resources Development Canada in cooperation with Statistics Canada, the NLSCY has contributed to our understanding of how to raise and level the bar. Many of the findings from the first cycle of this study are presented in *Vulnerable Children* (Willms, 2002). The primary message of this research is that the quality of children's environments within their families, their schools, and their local communities has a very strong effect on cognitive and behavioral development, and on the prevalence of childhood vulnerability.

Research based on the NLSCY calls for us to shift our thinking from seeing childhood vulnerability as a problem that stems simply from poverty and single parenting to seeing it as a problem arising from the environments in which children are raised. Four of the most important

factors related to childhood vulnerability uncovered in this research are parenting skills, the cohesiveness of the family unit, the mental health of the parents, and the extent to which parents engage with their children. These factors affect, and are affected by, the neighborhood, the school, and the wider community.

The social policy mandate to raise and level the learning bar requires more than simply offering parenting programs, increasing early childhood education, or improving schools. We need to renew social policy so that families and communities receive the support they need to raise their children well.

Improve Schools and Communities

With the PISA data, it is possible to estimate the range in students' scores from the worst-performing to the best-performing schools. In Hong Kong, this range is about 115 points — roughly equivalent to about two years of schooling for 15-year-old students.

Findings pertaining to the most important determinants as to why some schools do better than others is discussed in the last chapter of *Knowledge and Skills for Life* (OECD, 2001). The results indicate that the extent to which students make use of school resources, and the extent to which specialist teachers are available, can significantly impact student performance. Two factors pertaining to school climate — teacher morale and commitment, and school autonomy — were important factors in many countries and overall for the participating OECD countries. Finally, two aspects of classroom practice emerged as important factors affecting student performance: the disciplinary climate of the classroom and teacher-student relations. Overall, however, the PISA results suggest that no single factor explains why some schools perform better than others. Successful school performance is attributable to several factors associated with school resources, school policy and practice, and classroom practice. We also know from other research that student performance is higher in schools that practice heterogeneous grouping and team teaching, and in schools with a high level of parent involvement.

Some school reformers argue that to raise and level the bar we need to "restructure" schools to be more supportive and responsive to student needs, and to have a stronger orientation toward achieving success for all children (Fullan, 1992; Fullan & Stiegelbauer, 2001; Levin, 1987).

The models for reform are consistent with the messages from PISA: they emphasize prevention over remediation, a highly contextualized curriculum with strong components in reading and language, parent participation, and greater control for teachers and principals in managing school affairs.

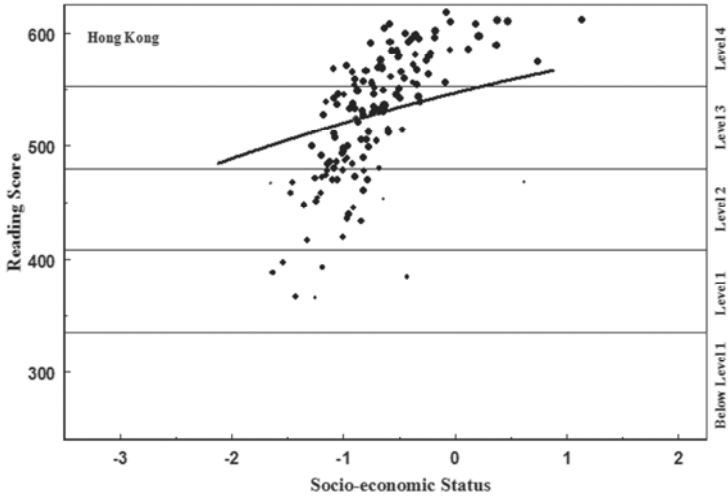
Reduce Segregation and the Effects of Poverty

One of the core findings of PISA is that there is a "contextual effect" on student performance associated with the average socio-economic status of the school, over and above the effects associated with students' individual family socio-economic status. This was evident in every participating country/region. For example, if a child of average socio-economic status attends a school with an above-average socio-economic status, the child will likely perform better than if he or she attends a school with a below-average socio-economic status.

Schools with a higher average socio-economic status tend to have several advantages associated with their context. In most countries they are more likely to have good resources — more computers or better-trained teachers, for example. They are also more likely to have an atmosphere that is conducive to learning, with fewer disciplinary problems, higher expectations for academic success, and greater parent support. Then too, positive peer effects happen when bright and motivated students work together. For these reasons, when students are segregated into different classes or tracks within a school, or into different schools within a community, students from advantaged backgrounds tend to do better, while those from disadvantaged backgrounds tend to do worse (Gamoran, 1992; Kerckhoff, 1986, 1993; Rumberger & Willms, 1992).

In Hong Kong, as in most other countries, children from differing family backgrounds are segregated to some extent due to residential segregation (Willms, 2004). Figure 2 shows the relationship between school mean reading achievement and school mean socio-economic status for Hong Kong. These data reveal that there are several Hong Kong schools with a concentration of children from disadvantaged backgrounds. There are also many very low performing schools. This segregation of students along socio-economic lines, and the large observed differences among schools in their attainment, are undoubtedly

Figure 2. School Profile for Hong Kong



Source: OECD (2000).

attributable also to the "banding" of students based on their prior academic achievement. The recent reforms in Hong Kong aimed at reducing the extent of "banding" is likely to help level the bar for Hong Kong students.

An important strategy for raising and leveling the bar is to avoid segregating youth into low and high socio-economic-status schools or programs. However, this is only the first step. We need strong leadership in schools and communities to promote social inclusion. This agenda would concentrate on not only reducing segregation associated with gender, ethnicity, disability, and economic disadvantage, but also recognizing and valuing student diversity, safeguarding students' rights to participate in mainstream activities, and providing access to the psychic rewards of schooling.

Parents and community leaders can promote social inclusion by encouraging inclusive structures and practices that meet the needs of diverse students. Doing so requires creating a different framework of understanding and values among parents of students in high-status classes and schools, and among the principals and teachers who work in those settings.

Concluding Remarks

The PISA findings suggest that the schooling outcomes of Hong Kong student are associated with socio-economic status, and vary considerably among schools. There is no single school or community factor that is all-important; rather, school performance is related to many factors, including the quality of early childhood education and children's opportunities to learn in and out of school. However, the PISA results do emphasize the role that school composition plays in affecting educational outcomes. Discussions about "banding" in Hong Kong need to consider not only the potential benefits of targeted curricula and vocational preparation, but also how it affects the allocation of human and material resources, as this has consequences for students' academic outcomes and engagement at school. Raising and leveling the learning bar in Hong Kong will not be achieved quickly or without substantial investment. It will require a vision of a comprehensive approach to educational provision that emphasizes equality of opportunity, and a collective will on the part of parents, educators, and the broader policy community to achieve this vision.

References

Adler, N. E., Boyce, T., Chesney, M. A., Cohen, S., Folkman, S., Kahn, R. L., & Syme, S. L. (1994). Socioeconomic status and health: The challenge of the gradient. *American Psychologist*, *49*(1), 15–24.

Andersson, B. E. (1989). Effects of public day-care: A longitudinal study. *Child Development*, *60*(4), 857–866.

Andersson, B. E. (1992). Effects of day-care on cognitive and socio-emotional competence of thirteen-year-old Swedish schoolchildren. *Child Development*, *63*(1), 20–36.

Arnett, J. (1989). Caregivers in day-care centers: Does training matter? *Journal of Applied Developmental Psychology*, *10*(4), 541–552.

Barr, R. G., Beek, P. J., & Calinoiu, N. (1999). Challenges to nonlinear modelling of infant emotion regulation in real and developmental time. In G. J. P. Savelsbergh, H. van der Maas, & P. van Geert (Eds.), *Non-linear developmental processes* (pp. 15–37). Amsterdam: Elsevier Science Publishers.

Burchinal, M. R., Roberts, J. E., Nabors, L. A., & Bryant, D. M. (1996). Quality of center child care and infant cognitive and language development. *Child Development*, *67*(2), 606–620.

Carnegie Corporation of New York. (1994). *Starting points: Meeting the needs of our youngest children*. New York: Author.

Fullan, M. (1992). *Successful school improvement: The implementation perspective and beyond*. Buckingham, England: Open University Press.

Fullan, M., & Stiegelbauer, S. (2001). *The new meaning of educational change* (3rd ed.). Toronto: Ontario Institute for Studies in Education.

Gamoran, A. (1992). The variable effects of high school tracking. *American Sociological Review*, *57*(6), 812–828.

Goelman, H., & Pence, A. R. (1987). Effects of child care, family, and individual characteristics in children's language development: The Victoria day care project. In D. Phillips (Ed.), *Quality in child care: What does the research tell us?* (pp. 89–104). Washington, DC: National Association for the Education of Young Children.

Grossman, M., & Kaestner, R. (1997). Effects of education on health. In J. R. Berhman & N. Stacey (Eds.), *The social benefits of education* (pp. 69–123). Ann Arbor, MI: University of Michigan Press.

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore : P.H. Brookes.

Howes, C., Phillips, D. A., & Whitebrook, M. (1992). Thresholds of quality: Implications for the social development of children in center-based child care. *Child Development*, *63*(2), 449–460.

Government of Canada. (2001). *Achieving excellence: Investing in people, knowledge and opportunity*. Ottawa: Industry Canada

Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M., & Lyons, T. (1991). Early vocabulary growth: Relation to language input and gender. *Developmental Psychology*, *27*(2), 236–248.

Kerckhoff, A. C. (1986). Effects of ability grouping in British secondary schools. *American Sociological Review*, *51*(6), 842–858.

Kerckhoff, A. C. (1993). *Diverging pathways: Social structure and career deflections*. Cambridge, England; New York: Cambridge University Press.

Lazar, I., Darlington, R., Murray, H., Royce, J., & Snipper, A. (1982). *Lasting effects of early education: A report from the Consortium of Longitudinal Studies*. Chicago, IL: University of Chicago Press for the Society for Research in Child Development.

Levin, H. M. (1987). New schools for the disadvantaged. *Teacher Education Quarterly*, *14*(4), 60–83.

McCartney, K. (1984). Effect of quality of day care environment on children's language development. *Developmental Psychology*, *20*(2), 244–260.

Olds, D. L., Eckenrode, J., Henderson, C. R., Jr., Kitzman, H., Powers, J., Cole, R., Sidora, K., Morris, P., Pettitt, L. M., & Luckey, D. (1997). Long-term effects on home visitation on maternal life course and child abuse and neglect: 15-year follow-up of a randomized trial. *Journal of the American Medical Association*, *278*(8), 637–643.

Olds, D. L., Henderson, C. R., Jr., Cole, R., Eckenrode, J., Kitzman, H., Luckey, D., Pettitt, L. M., Sidora, K., Morris, P., & Powers, J. (1998). Long-term effects of nurse home visitation on children's criminal and antisocial behavior: 15-year follow-up of a randomized controlled trial. *Journal of the American Medical Association*, *280*(14), 1238–1244.

Organisation for Economic Co-operation and Development. (2000). *PISA 2000 Database*. Retrieved July 15, 2003, from OECD PISA Web site: http://pisaweb.acer.edu.au/oecd/oecd_pisa_data_s1.html

Organisation for Economic Co-operation and Development. (2001). *Knowledge and skills for life: First results from the OECD Programme for International Student Assessment (PISA) 2000*. Paris: Author.

Organisation for Economic Co-operation and Development, & Statistics Canada. (2000). *Literacy in the information age: Final report of the International Adult Literacy Survey*. Paris: OECD; Ottawa: Statistics Canada.

Organisation for Economic Co-operation and Development, & UNESCO. (2003). *Literacy skills for the world of tomorrow: Further results from PISA 2000.* Paris: OECD & UNESCO Institute for Statistics.

Osborn, A. F., & Milbank, J. E. (1987). *The effects of early education: A report from the child health and education study*. Oxford: Clarendon Press.

Peterson, C., & Peterson, R. (1986). Parent-child interaction and daycare: Does quality of daycare matter? *Journal of Applied Developmental Psychology*, *7*(1), 1–15

Phillips, D. A. (1987). *Quality in child care: What does the research tell us?* Washington, DC: National Association for the Education of Young Children.

Ross, C. E., & Wu, C. (1995). The links between education and health. *American Sociological Review*, *60*(5), 719–745.

Rumberger, R., & Willms, J. D. (1992). The impact of racial and ethnic segregation on the achievement gap in California high schools. *Educational Evaluation and Policy Analysis*, *14*(4), 377–396.

Shore, R. (1997). *Rethinking the brain: New insights into early development*. New York: Families and Work Institute.

Wasik, B. H., Ramey, C. T., Bryant, D. M., & Sparling, J. J. (1990). A longitudinal study of two early intervention strategies: Project CARE. *Child Development*, *61*(6), 1682–1696.

Willms, J. D. (2002). *Vulnerable children: Findings from Canada's National Longitudinal Survey of Children and Youth.* Edmonton, AB: University of Alberta Press.

Willms, J. D. (2003a). *Student engagement at school: A sense of belonging and participation. Results from PISA 2000.* Paris: Organisation for Economic Co-operation and Development.

Willms, J. D. (2003b). *Ten hypotheses about socioeconomic gradients and community differences in children's developmental outcomes*. Quebec: Human Resources Development Canada.

Willms, J. D. (2004, October). *Contextual effects on student outcomes*. Paper presented at the Jacobs Foundation Conference on Educational Influences, Öhningen, Germany.

Willms, J. D., & Beswick, J. F. (2003). *The early years evaluation: An instrument for assessing children's learning, behaviour, and health upon entry to school.* Fredericton, Canada: KSI Research International.