

Measures of Socio-Economic Status in Educational Research: The Canadian Context

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Abstract This study aims to recommend and test a conceptual model for socio-economic status (SES) and variables to measure it that are available to researchers in Canada and applicable in other countries. Recommendations for quantitative researchers are presented to address issues that arise with including SES in analyses. The study analyzed data linking student achievement in mathematics and literacy to both economic and social factors. Results from hierarchical linear modelling showed that the use of intersecting variables was better served to answer research questions than any individual SES measure or a composite measure. Using SES measures at the school and neighbourhood level is also recommended.

Keywords Socio-economic status; Student achievement; Hierarchical linear modelling; Canadian context

Introduction

One purpose of educational research is to determine factors that influence student academic success in order to recommend changes to policy and approaches to leadership. Over the last three decades, quantitative researchers have come to depend

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on measures of socio-economic status (SES) as part of this process. Michael Harwell and Brandon LeBeau (2010) note that:

Analyses of educational data often include student background variables as statistical controls to enhance the credibility of inferences. One of the most frequently used student variables is socioeconomic status. (p. 120)

In order to determine if interventions, leadership actions, and policy decisions have an impact, “SES is taken into account statistically to ensure that the program’s effectiveness is evaluated independent[ly]” (Harwell, 2018, p. 3). Data about income levels and poverty are also used to allocate resources in many jurisdictions. As well, by controlling for SES, researchers are able to compare results across schools, districts, provinces, states, and even countries. However, the use of student SES as a variable in statistical analysis is complicated by the fact that researchers do not always have access to the same measure. As well, SES can be measured at different aggregate levels (individual, school, neighbourhood, and district). There is a need for accessible, reliable, and valid measures of SES because of the important decisions being made in education with this data. One option for a consistent measure is to use federal-level data based on family income. For example, in the United States there is a measure of whether students qualify for a free or reduced-price lunch (FRL) based on family income. In the United Kingdom there is an income-based measure to determine whether students receive a free school meal (FSM). However, a similar measure of SES does not exist for studies based in the Canadian context. In Canada, education is the purview of provincial and territorial governments, which means that there is not a consistent measure across the country. Researchers in Canada, and in other countries, need reliable, valid, and consistent measures of SES. The purpose of this article is to review past practices and options for SES measures that are available in Canada and then develop a conceptual model. Data from a previous study (Leithwood, Patten & Jantzi, 2010) will be reanalyzed using hierarchical linear modelling to test the model and determine measures of SES that are available in the Canadian context and can be recommended for use by quantitative researchers.

Theoretical background

The assertion that SES is an influential factor began in the United States with a report by James Coleman (1966) and in the United Kingdom with a report by Gilbert Peaker (1971). In both reports it was “concluded that family background was more important than school factors in determining children’s educational achievement” (Buchmann, 2002, p. 166). This perspective continues to inform research as:

the theoretical framework sociologists use to examine inequalities presumes that academic attainment, and ultimately occupational attainment, are largely determined by family origins and educational experiences. (Willms, 1999, p. 9)

The Coleman (1966) and Peaker (1971) reports and other studies that have followed, suggest that the “socioeconomic status (SES) of families explains more than half of the difference in student achievement across schools” (Leithwood, Louis,

Anderson, & Wahlstrom, 2004, pp. 46–47). Other research has determined that family related factors account for as much as 50 percent of the variation in student achievement across schools (Kyriakides & Creemers, 2008). Larger studies, including meta-analyses, have found a strong link between socio-economic factors and student academic achievement (Caro, McDonald, & Willms, 2009; Fan & Chen, 2001; Fan & Williams, 2010; Nagy, Traub, & Moore, 1999; Sirin, 2005). In a report Michael Harwell (2018) states:

SES is a core facet of much educational research and policy because of the perceived importance of taking into account disparities in SES among students, classrooms, and schools to help ensure accurate inferences about student learning and achievement. (p. 6)

A literature review of leadership effects on student achievement determined that empirical evidence supported four claims about family background:

1. A family's SES is strongly related to student learning and behaviour.
2. A family's SES influences learning indirectly by shaping educational culture in the home.
3. Strong family educational culture provides children with intellectual, social, and emotional capacities that improve their chances of being successful in school.
4. Wider communities in which children live also contribute to the capacities needed for school success. (Leithwood et al., 2004)

There is an entrenched belief in data-based educational research that SES must be accounted for when quantitatively evaluating student achievement in response to interventions, leadership actions, and policy. This article seeks to recommend conceptual models for SES measures that are available in the Canadian context and will be useful for research in education.

Literature review

For such an essential measure, there is little agreement about how to represent and measure SES both within and between countries. As well, the selection and availability of SES factors has changed over the last five decades. Once SES was found to have an impact on students' achievement throughout the 1970s, researchers began to rely on single measures beginning in the 1980s. With the development of more sophisticated data analysis, the use of a single, dichotomous variable has been challenged. More researchers are testing the use of composite variables or including multiple measures of SES to address many sources of variance. The literature review gives an overview of measures that have been previously used, as well as an evaluation of those that are most useful for educational researchers in the Canadian context.

Single measures

A variety of studies choose to represent and measure the effect of SES using a single variable. As seen in Selcuk Sirin's (2005) meta-analysis, two of the most prevalent single measures are parental education and parental occupation. These both connect

to the presumption that the economic status of the parents influences the educational and future occupational outcomes of the child (Willms, 1999). A proxy measure for family income used in the United Kingdom is the percentage of students eligible for an FSM, because eligibility is based on family income and whether the family is receiving government assistance (Gorard, 2012; Hobbes & Vignoles, 2010). While the local school authorities do not collect information about individual income, the percentage of students eligible for an FSM in a school is readily available from school administrations at no cost, which makes it an attractive measure for researchers. Similarly, one of the most-cited measures of SES in quantitative studies in the United States is the percentage of students who qualify for FRL lunches, which is determined by federal government funding allocations and based on household income (Harwell, 2018; Kurki, Boyle, & Adaljem, 2005). There is an assumption that eligibility for FRL can be used to measure income and, subsequently, SES because:

Students are eligible for a reduced price lunch if their household income is less than 185% of the federal poverty guidelines and for a free lunch if their household income is less than 130% of the poverty guidelines. (Harwell & LeBeau, 2010, p. 122)

All of these single-indicator measures connect back to the premise that SES is meaningfully represented only as a function of family income, parent occupation, or parental education.

There are both benefits and problems with using a single measure to represent SES. A single measure is easy to collect, especially for large data sets, and can be accessed for very little cost (Harwell & LeBeau, 2010). The information can also be collected unobtrusively as it is often available publically, which avoids the problems associated with asking students about the SES of their families (Merola, 2005). When SES is being measured to serve as a control variable, only using one value simplifies calculations and avoids the problems associated with missing data. However, some reports criticize using family income as a crude proxy variable for SES because although income is related to family educational culture, it cannot account for other interactions or influences in the family or community (Cabrera, Karl, Rodriguez, & Chavez, 2018; Leithwood et al., 2004; Roebuck, 2017). By only using one variable, studies can overestimate SES effects. When studies adjust for family background but only use one measure, this leads to what Peter Hill and Kenneth Rowe (1996) call under specification, in that not all relevant aspects of family background are included and “the impact of unreliability in intake measures invariably leads to over-estimates of the proportion of variance at the student level” (p. 10). Another issue when only using one measure is the possibility of an imperfect binary. Some studies will set up a dichotomous measure as a proxy for income, for example, students who qualify for an FSM and those who do not. However, not all students who qualify for an FSM are in the lowest-income households, which results in an imperfect proxy bias (Hobbes & Vignoles, 2010) and an “unreliable approximation of SES, since the true value of the underlying concept is continuous” (van Ewijk & Slegers, 2010, p. 138). There can also be issues when an FRL is used as an aggregate at the school level as “enrollment rates provide an imprecise measure of school-level economic advantage” (Domina, Brummet, Pharris-Ciurej, Porter, Penner, Penner, & Sanabria, 2017, p. 2).

The literature reviewed shows that there are both benefits and problems associated with using a single measure of SES that researchers must consider. As well, when conducting research outside of the U.S. or the U.K., there are no equivalent measures to use as proxies for family income.

Multiple measures

Another approach in educational research is to conceptualize SES as a combination of factors. These studies often use a traditional measure of SES (income, parental occupation, or parental education) coupled with measures of family resources, educational culture, or neighbourhood influences. The American Psychological Association Task Force (APA, 2007) report states that SES must be considered in context with other constructs and an “intersectional approach considers these constructs as multiple, interlocking dimensions of social relations” (p. 8). There are examples of studies that consider multiple measures of SES. Doris Entwisle and Nan Astone (1994) recommend that researchers use family income, the mother’s education level, and information about the family structure (e.g., the number of birth parents, step-parents, or grandparents in the home). In a study of the impact of school organizational culture on student achievement, a sociocultural capital index was used based on both parent’s highest education levels and the number of books in a student’s home (Dumay, 2009). Research studies have also looked at family background and characteristics to help explain the variance in student achievement. In a Canadian study, Xin Ma and Don Klinger (2000) estimated a variable called SES using student reports of “education related possessions at home and their participation in social and cultural activities, rather than parental income or occupation” (p. 44). The same study measured the number of parents in the home (two or one) and created a variable called Parental Involvement by asking students how much a parent helped with homework and talked about the importance of school. In a study of secondary students results on a literacy test in Ontario, the level of mean family income in the neighbourhood of the school was measured in conjunction with access to a computer and literary resources at home (Klinger, Rogers, Anderson, Poth, & Calman, 2006). A link between a family’s access to resources and a student’s academic achievement is seen when SES is measured with multiple variables. Using an intersection of factors also provides researchers with the ability to conceptualize SES in a broader sense. However, some difficulties when working with several intersecting measurements are collecting accurate data and being able to determine which variables have had a significant influence. As well, as seen in the examples, the conceptualization of SES is not consistent.

A further extension of this research approach is to use composite measures, where several factors are accounted for, but the analysis only uses a single value derived from the measures. One composite measure is called the Social Risk Index (SRI). Human Resources Development Canada (HRDC, 2003) developed it as a way to profile the SES and potential risk factors in communities, such as low income, high mobility, or high unemployment rates. It includes nine variables available from Canadian census data: average household income, unemployment rate, proportion of adults without a high school diploma, proportion of homeowners, mobility, speak-

ing an official language, proportion of recent immigrants, lone-parent families, and reliance on government transfer payments. The composite scores results in a number from zero to nine, with higher scores indicating an increased level of social risk. A composite accounts for a variety of factors influencing SES at a neighbourhood level, yet still provides a single value for use in calculations.

As with other methodological approaches, there are problems with composites. The APA (2007) task force cautions against their use:

one should be careful about creating a composite measure. It is generally more informative to assess the different dimensions of SES and understand how each contributes to an outcome under study rather than merge the measures. (p. 11)

Many composite measures use data gathered from a country's census. There can be an issue with this reliance on census data:

The main drawback of census-based poverty measures is the fact that full census data are collected and published only every 10 years. Although neighborhoods do not change overnight, significant changes do take place over the course of 10 years, and the student composition of schools is likely to change even faster. (Kurki et al., 2005, p. 7)

Even in Canada, where census data is collected every five years, there is a possibility that neighbourhoods may change over that time. Composite measures can provide a representation of SES that involves many factors, but whether they are applicable or available in a specific context needs to be taken into account.

Levels of measurement

A consideration for researchers is whether the data will be collected from individual students, aggregated at the school level, or taken from the neighbourhood around the school. The most comprehensive and accurate picture of SES comes from questioning an individual or family members about their lives. However, very few large-scale quantitative studies can afford the time and cost associated with collecting accurate data from individuals. Often, university-based researchers are not allowed access to students. In the case of younger children, they cannot accurately answer income, occupation, or parental education-level questions, so their parents must be contacted to provide accurate information (Kurki et al., 2005; Viadero, 2006). There are also issues of privacy around SES, such that the Programme for International Student Assessment and other international studies do not allow students to be questioned about income (May, 2002). Individual non-response to questions about SES results in missing data and undermines the study (Hauser, 1994). The next level of aggregation is to calculate values to represent the whole school. Several meta-analyses have found a strong correlation between SES and student achievement when aggregated at the school level (Hattie, 2009; Sirin, 2005; White, 1982). Karl White (1982) found that the correlation between SES and academic achievement was stronger when aggregated to the school level, rather than at an individual student level. Similarly, Sirin (2005) determined that:

of all the factors examined in the meta-analytic literature, family SES at the student level is one of the strongest correlates of academic performance. At the school level, the correlations were even stronger. (p. 438)

Fortunately, in Canada, school-level achievement and economic data is often available publically through the provincial or territorial education ministry. The next level of aggregation is to use SES values that represent the neighbourhood surrounding the school. An argument is that neighbourhood data is a better alternative because “the immediate geographic area where a person lives fundamentally moulds that individual’s life chances: his or her educational, social and financial future” (Kurki et al., 2005, p. 3). Psychological research has shown that the perception of social rank within the neighbourhood also has an impact on student well-being (Roebuck, 2017). The belief that neighbourhood SES is important for student success is seen at work at the Ontario Ministry of Education (OMOE). Information on the percentage of school children from low-income households who are recent immigrants, whose parents have less than a high school diploma, and who come from single-parent families, determines an amount of additional funding to school districts (OMOE, 2010). The ministry uses data from the Statistics Canada census for each dissemination area (DA) linked to postal codes in the province. The OMOE uses student home address postal codes to determine what percentage of each school’s population is in each DA, then weights the census data to provide a more accurate picture of each school’s neighbourhood demographics. Philip Nagy, Ross Traub, and Shawn Moore (1999) refer to this as the enrollment method, where:

the demography of a school is indexed in terms of the demography of those parts of the catchment area and beyond that are represented by the students attending the school ... which requires the postal codes of the students attending the school. (p. 37)

This comparative study found that the enrollment method for measuring SES correlates more strongly with student achievement (Nagy, et al., 1999). The Government of British Columbia uses Statistics Canada data for six indicators and analyzes it by district to determine social economic indicators (BCStats, 2013). However, this level of analysis is too time consuming for individual researchers and not all Canadian provinces track the same data, so there is not a consistent country-wide measure or aggregate level for researchers. However, if a provincial government makes these measures publically available, then they can be reliable and useful for educational research.

Criteria for use of SES measures

As mentioned previously, a researcher must carefully consider the scope and purpose of his or her study when deciding on the most appropriate measure of SES and the level of aggregation to use for the data. Some factors that influence research design and the way that SES is measured are the type of information that is publically and freely available and the scope and timelines of the study (Harwell, 2018; Harwell & LeBeau, 2010; Merola, 2005). It is important to include a measure of SES in quanti-

tative study design, but how do researchers determine an appropriate measure? Robert Hauser (1994) outlines three important characteristics of an SES variable: it must be easy to measure, be measurable for every child involved in the study, and must not vary over the short term. Stacey Merola (2005) explained some of the difficulties with accumulating SES data if parents could not be interviewed and the “need to balance the very real concerns of cost and obtrusiveness with the need to collect valid data” (p. 3). The American Psychological Association (APA, 2007) report on the use of SES in research is clear that researchers must base their choice of SES measure on a specific theory so that it truly relates to the outcome being studied. Based on the work of the APA and several other research studies, Harwell and LeBeau (2010) outline an approach for researchers to follow. Researchers should begin with “a clear conceptualization of SES and select one or more variables that capture the relevant circumstances of a student’s SES consistent with that conceptualization and the purpose of the study” (p. 126). The conceptualization of SES needs to be part of the design phase in research.

Researchers must strike a balance when finding useable measures of SES for analysis that are accessible at a reasonable cost and valid and reliable for the researcher’s conceptualization. There are measures that require little work on the researchers’ part, such as the percentage of students qualifying for an FRL or FSM. These values are already calculated by the school or district and they are collected each year. However, there is criticism that an FRL is not valid or reliable because the information is based on self-reporting and it is a crude measure of income (Domina et al., 2017; Harwell, 2018; Harwell & LeBeau, 2010; Viadero, 2006). There are also questions about the validity of any study that only uses one measure of SES (APA, 2007; Cabrera et al., 2018; Hill & Rowe, 1996) that is tied to family income. There are more factors that influence student achievement than just income level.

Researchers may conceptualize socio-economic measures as combined variables and composite measures. Examples of this type include both income and educational resources in the home or parental education. A study found that a proxy for income worked better when combined with other measures of SES (Cabrera et al., 2018). These measures, both economic and social, may be available from schools or can be calculated with publically available information. Again, researchers need to think carefully about the conceptualization of SES, preferably in the early stages of planning and before data collection begins.

Purpose

Based on the literature review, the hypothesis of this article is that the calculation of intersecting variables better serves to answer research questions than any individual or composite measure and that SES should be measured at the school and neighbourhood level. Socio-economic status should be conceptualized and measured as the result of both economic and social influences (APA, 2007; Cabrera et al., 2018; Dumay, 2009; Entwisle & Astone, 1994; Leithwood, Patten & Jantzi, 2010; Klinger et al., 2006). As well, Lisa Nicholson, Sandy Slater, Jamie Chriqui, and Frank Chaloupka (2014) recommend “that multiple components should be measured and used separately in the models” (p. 57). In the Canadian context, data for the areas

surrounding schools is publically available and a study is able to measure several factors with a reasonable level of cost of access and calculation. By aggregating data at the school or neighbourhood level, the issue of individual non-response is eliminated and a researcher is better able to measure neighbourhood effects (Nagy et al., 1999). The next step in continuing this research is to test measures of SES using data from multiple district school boards in Ontario and compare several approaches to analysis to see which better explains the variance within student achievement results in mathematics and literacy.

Methods

The survey data used for this analysis was collected in the spring of 2009 as part of a larger project on educational leadership (Leithwood, Patten & Jantzi, 2010). For this study, the achievement and SES measures collected were reanalyzed. Hierarchical linear modelling (HLM) was used to test how different measures of SES explained the variance in mathematics and literacy scores in elementary schools. The first level of analysis used mathematics and literacy scores for the school as the outcome variable and measures of SES were the predictors. The second level of analysis accounted for different types of school district, whether public, Catholic, or French. The analysis was completed using HLM 7 from Scientific Software International and procedures outlined by Stephen Raudenbush and Anthony Bryk (2002).

There were responses from 219 elementary schools across 34 district school boards in Ontario. However, due to missing data only 199 schools are included in the analysis. In Ontario there is province-wide testing of literacy and mathematics in Grades 3, 6, 9, and 10. The outcome variable measuring student achievement is the percentage of students at the school who achieved or exceeded the provincial standard on the standards-based assessment. The value used in this analysis is the average of the success rate in math or literacy testing for all participating students at the school. The measures of SES included the effect of family background measured using both school- and neighbourhood-level variables. A composite variable that was tested included three measures of the SES of families in the community around the school: the income of households expressed as a percentage of the highest income in the sample, the percentage of two-parent families in the community, and the percentage of adults in the area who attained some post-secondary education. Each of these three measures was also tested as an independent predictor of achievement. A measure of the education culture and resources within the home were two predictors that represented the percentage of students at each school who reported that they had adult support for homework and a computer available for their use in the home. The data on support in the home was collected through surveys given to each student who wrote the provincial test and was aggregated and reported publically for each school by the testing agency.

Results

The data for each school was entered into SPSS Statistics 24 and the descriptive statistics are presented in Table 1.

Table 1. Descriptive statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Math achievement	65.53	14.06	25	98.5
Literacy achievement	66.55	12.45	22.25	97.5
SES composite	58.92	7.21	43.35	91
Family composite	38.62	4.89	15.25	51.50
Income level	34.67	8.58	17.14	100
Two parents	84.21	5.32	66	96
Higher education	57.88	13.24	26	93
Adult help	15.61	4.43	2	30.5
Computer at home	61.62	9.7	12	88.5

To test the hypothesis that using an intersection of factors would better explain the variance in math and literacy test scores, the outcome variable represented the percentage of students who wrote the test and scored at or above the provincial standard for their grade. Prior to the analysis, the composite variables created were tested for internal reliability. The internal consistency of both variables was checked using the value of Cronbach’s alpha (α). For the SES composite the value was $\alpha = 0.802$, which is considered strong. However, for the Family composite the value was $\alpha = 0.542$, which is weak. Therefore, only the SES composite was used in the analysis. The two Family predictors were retained but were used as separate variables.

The first analysis used the achievement data for the province-wide mathematics test as it had a larger standard deviation and more variance within the school scores. The use of multilevel regression accounts for the nested nature of the data. The assumption is that if schools are part of the same district school board, they will follow similar policies and procedures and any variance within the district could be due to socio-economic factors. For all of the models the residual effects, μ_{0j} , were assumed to be normally distributed with mean 0 and variance τ_{00} . The analysis was run with restricted maximum likelihood because of the sample size. An analysis of the unconditional model was run in order to determine the mean value of all scores and how much variance occurred within schools in the same district school board and how much variance occurred between district school boards.

$$\text{Level 1 Model: } \text{MathAchievement}_{ij} = \beta_{0j} + r_{ij} \quad r_{ij} \stackrel{iid}{\sim} \mathbf{N}(\mathbf{0}, \sigma^2)$$

$$\text{Level 2 Model: } \beta_{0j} = \gamma_{00} + \mu_{0j} \quad \mu_{0j} \stackrel{iid}{\sim} \mathbf{N}(\mathbf{0}, \tau_{00})$$

For the unconditional model, the overall grand mean score for Math Achievement_{ij} was 65.5 ($t = 44.5, p < 0.001$), which represents that, on average, 65 percent of students in Grades 3 and 6 in the sample are achieving the provincial standard in math.

The main objective of running the unconditional model was to determine if there was variance either within schools in the same district or between schools in different districts. The variance within schools was $\sigma^2 = 171.8$ and the variance be-

tween school districts was $\tau_{00} = 27.7$. The interclass correlation (ICC), which represents the proportion of variance between districts, is 14 percent, so the difference within schools in the same district accounts for 86 percent of the variance.

The next step of the analysis added predictor variables to represent the socio-economic factors in the neighbourhood and show the relationship to student achievement in order to explain some of the variance. Two different models were run to determine whether SES explains more of the variance when analyzed as a composite measure or as separate predictors. Model 2 was run with just the composite SES and Model 3 was run with the three separate economic predictors representing the neighbourhood surrounding each school (level of income, two-parent families, and levels of higher education). All of the variables were grand-mean centred following the procedures in Raudenbush and Bryk (2002). Any variables that were too small, with coefficients less than 0.10, and not statistically significant, with a p value greater than 0.10, were dropped. After the first run of Model 3, the variable of Income Level was dropped as it was not statistically significant.

Table 2. Comparison of two models using a composite measure versus separate predictors

	Model 2	Model 3
Math achievement—grand mean β_0	65.5	65.5
Variance within school districts σ^2	142.6	142.2
Variance between school districts τ_{00}	31.7	31.7
Relationship of predictors to student achievement	SES $\gamma_{10} = 0.83$ $t = 6.08, p < 0.001$	Two parents $\gamma_{10} = 0.69$ $t = 3.54, p < 0.001$ Higher education $\gamma_{20} = 0.30$ $t = 3.60, p < 0.001$

As can be seen in Table 2, the composite and separate predictors explain the same amount of variance in the reduced model. By accounting for socio-economic factors, 17 percent of the variance within districts is explained. However, the model with two factors provides more details to the researcher. As well, the APA (2007) guidelines recommend including more dimensions of SES in order to understand how each contributes to student achievement. Therefore, Model 3 was retained for the analysis.

The next step in the model was to add two predictors to represent the social factors in the family, whether a parent was available to help with homework and if a computer was available in the home. During the analysis, the predictor for adult help with homework was not statistically significant and was dropped. Model 4, the final model, with three predictors of SES is presented in Table 3. Adding the three predictors for different aspects of SES explained 30 percent of the variance in mathematics achievement within school boards. Overall, the results show that, on average, 65 percent of students meet the provincial standard in mathematics.

Table 3. Relationship between student achievement and socio-economic predictors

Model 4 Results	
Math achievement—grand mean β_0	65.5
Variance within school districts σ^2	120.9
Variance between school districts τ_{00}	35.33
Relationship of predictors to student achievement	
Computer in the home	$\gamma_{10} = 0.57$ $t = 5.57, p < 0.001$
Two parents	$\gamma_{20} = 0.60$ $t = 3.30, p = 0.001$
Higher education	$\gamma_{30} = 0.18$ $t = 2.32, p = 0.022$

The three predictors of SES all have a positive relationship with math achievement. The higher the percentage of students that have a computer available in the home, the higher the overall scores ($\gamma_{10} = 0.57$). There is a similar positive relationship when the neighbourhood around the school has a higher percentage of two-parent families ($\gamma_{20} = 0.60$). The effect of having more adults in the neighbourhood with education beyond the high-school level is smaller, but still positive ($\gamma_{30} = 0.18$). All of these predictors show that in this data set, SES does account for and explain some of the variance in mathematics achievement within (30%) and between (27%) district school boards.

The same procedure was used to analyze the data using the success rate of students on the province-wide literacy test of reading and writing. The results were very similar. The use of the same three predictors explained 29 percent of the variance within schools in the same district. All three predictors had a positive relationship with literacy achievement: computer in the home $\gamma_{10} = 0.46$, two-parent family $\gamma_{20} = 0.33$, level of higher education $\gamma_{30} = 0.23$. This finding extends the use of the conceptual model of SES as a combination of economic status, family composition, and resources available in the home.

Discussions and recommendations

The purpose of this study was to recommend and test a conceptual model for SES and variables to measure it that are available to researchers in Canada and still applicable in other countries. The analysis for this sample showed that there was not a statistical benefit to using a composite variable in comparison to the use of separate variables. The recommendation is that multiple predictors of SES should be used in educational research. There are too many problems both conceptually and statistically with only using one single measure of SES. Socio-economic status should be conceptualized and measured as the result of both economic and social influences (APA, 2007; Cabrera et al., 2018; Dumay, 2009; Entwisle & Astone, 1994; Klinger et al., 2006; Leithwood, Patten & Jantzi, 2010). Conceptually, including a measure of status by education or income is imperative. Adding additional variables to measure family composition, such as two-parent versus single-parent households, and

resources, such as books or computers in the home, gives researchers a better understanding of the many facets of SES and how it can impact student achievement. Based on the literature reviewed and the measures tested, a combination of predictors in this study explained approximately 30 percent of the variance within districts. A further recommendation is that quantitative researchers use data based on what is publically available in their province, state, or country. Using data collected through a government agency saves time, effort, and cost for individual researchers. Working with data that is aggregated to the school and neighbourhood level results in less missing data and accounts for neighbourhood effects. As well, the work done by Statistics Canada and other government agencies is reliable, timely, and the measures are explained clearly.

Limitations and future research

A limitation of this study is that the data collected were based on only one time period. Changes in SES can be difficult to track over time, but it would be interesting in future research to try and determine if changes in achievement scores reflected changes in neighbourhood demographics. As well, all of the data was collected from public sources and was aggregated at the school and neighbourhood level. For this reason it is inappropriate to make assumptions about individual student achievement. The socio-economic predictors used did not account for all of the variance, but as stated previously, SES is only used to ensure that the testing and inferences about other factors being investigated is accurate.

Conclusion

The study was a response to the need for Canadian educational researchers to have a valid way to conceptualize and measure SES. The recommendations provided and tested outline a consistent approach to quantitative analysis that includes predictors for SES. Researchers should conceptualize SES as a combination of factors and use measures that include economic factors, family composition, and educational resources. There will always be issues with the use of statistical proxies and trying to quantify all of the factors that impact student achievement. Researchers in all jurisdictions can benefit from reflecting on their own practices in how they conceptualize and measure SES when making their own conclusions in quantitative research.

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