Learning Ecologies and Indigenous Readers: An Examination of the Influence of Home Factors on Indigenous Students' Reading Achievement

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Abstract

Students learn in a complex interplay of numerous variables such as contexts, processes, relationships, affordances, and spaces. This interplay is termed as learning ecology. Each individual's learning ecology is made up of four primary elements: the learner, the environment, their interactions with the environment, and the learning that emerges from these interactions. The purpose of this study was to examine the relationships between the reading achievement of fourth-grade Indigenous students in the United States and home factors related to material aids to reading in the home and the economic circumstances of the family. Data was gathered from the National Indian Education Survey using the National Assessment of Educational Progress (NAEP) Explorer tool. Specifically, data used for the present study was extracted from the 2015 NAEP dataset. The research methods used include quantitative descriptive analysis, correlational analysis, t-test and Cohen's d effect size with the overall purpose of examining the relationship between home environment factors and reading achievement. The results of data analysis showed a consistent relationship between seven home environment variables selected and levels of reading achievement on the NAEP reading test. These findings may indicate an evident need for greater attention to be paid to the health of the learning ecologies of American Indian/Alaskan Native adolescents in order to identify cases where those affected by social disadvantage are likely also to be achieving academically at a lower standard than their more affluent peers.

1. Introduction

Every learner exists within a complex interplay of contexts, processes, relationships, affordances, and spaces, and from this interplay grows what has come to be termed their learning ecology. Each individual's learning ecology is made up of four primary elements: the learner, the environment, their interactions with the environment, and the learning that emerges from these interactions [1]. The concept of personal learning ecologies grew out of related research into out-of-school learning and the contrast between formal and informal learning settings [2]. In her 2006 paper, Barron

conceptualized a learning ecology framework to aid in examining the ways in which adolescents create their own learning opportunities or make use of the opportunities that are presented to them. These opportunities occur in contexts that encompass all of school, home, neighborhood and community environments. In this study, Barron's learning ecology framework provided a springboard for pursuing questions related to the learning ecologies of Indigenous students, more specifically what part home influences play in the reading achievement of this particular set of learners.

Barron's [2] concept of a learning ecology being a set of physical and virtual contexts that surround each child and

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that offer opportunities to engage in both formal and informal learning has particular relevance to my research problem. Information about the home environment of an adolescent learner can tell us much about the learning opportunities this environment may offer a child. According to Barron's learning ecology framework, every setting is made up of "a unique configuration of activities, material resources, relationships, and the interactions that emerge from them" (p. 195). Although material resources are included as an element within the framework, the bulk of the influencing elements within the ecology are centered on what occurs in each setting to contribute to the learning process. Little consideration within the framework is given to the influence the physical environment may have on the learning process, and as such, this represents something of a limitation Barron's original conceptualization of a learning ecology holds in terms of this present study.

Another limitation is that a learning ecology appears predicated on recognizing and examining the positive impact on learning of what is, to the detriment of examining what is not. A great deal is known, for example, about the home environment factors that positively influence such things as reading achievement. For instance, maternal intelligence, positive parenting practices, the presence of books in the home, private study spaces, and unimpeded access to a computer, can all positively influence levels of reading achievement [3, 4]. All of these things would contribute to a healthy learning ecology for the child who enjoys their benefits, but how healthy is the learning ecology of a child who does not?

2. Literature Review

Since social disadvantage can be the cause of many of these elements missing from the home environment of many Indigenous children in the United States, this raises questions about the nature of the relationship between home factors and the reading scores of Indigenous children, and whether in fact more can be determined about the learning ecologies that exist around Indigenous adolescent learners. It is not the purpose of this paper to examine an alternative concept of the unhealthy learning ecology, but rather to examine some of the elements that might arguably deem it necessary to consider whether such a concept does indeed need exploring.

This research problem in this study was therefore concerned with whether a relationship exists between the reading scores of Indigenous students and aspects of their home life, such as access to material resources that provide opportunities for learning outside of school. The results of this study could be of particular interest to elementary school teachers in areas where the number of Indigenous children in schools is

unusually high. It could also be of interest to members of Indigenous communities seeking to take a proactive role in improving educational outcomes for their children. The collectivist nature of Indigenous groups in North America means that the most influential forces for change can often come from within communities where self-determination and cultural values associated with the well-being of the group are paramount.

2.1. Socio-Economic Status and Reading Achievement

Previous research has already found that the nature of the home environment can significantly impact academic achievement, particularly in relation to reading. In a study by Molfese, Modglin, and Molfese [3] the authors were interested in home environment factors that influence reading skills since reading skills are already understood to be reliable indicators of cognitive ability. Molfese had found in previous longitudinal studies that both home environment variables (measured using the Home Observation for Measurement of the Environment inventory) and socio-economic status (SES measures) had an impact on intelligence scores. In the 2003 study [3], Molfese et al. found a healthy relationship between HOME scores and SES scores and reading ability in particular. This study, however, was conducted with white children only.

Koppenhaver [5] also examined the impact of home factors on reading achievement, relative to socio-economic status. While this author focused primarily on social factors within the home environment related to such things as parenting habits, the number of other children in the home, and involvement of parents in the child's learning, many economic variables related to possessions were included in the inventory used. These included the ownership of books, dictionaries and encyclopedias, a study desk, and home appliances. While Koppenhaver's study produced evidence of a disparity in reading achievement between children of high and low socio-economic status, the number of Indigenous children included in the sample was so low as to represent, to the nearest whole percent, 0% of the total sample, while children identified ethnically as white represented 94% of the sample. In addition, the variables related to material resources were not statistically analyzed separate from all of other social and environmental variables included in the study and could not, therefore, be examined for evidence of a relationship in isolation from all other influences.

A European study by Jehangir, Glas, and van den Berg [6] from the Netherlands evidenced the inequalities in academic achievement wrought by socio-economic status and sought to pay close attention to the background variables in the home which may influence this relationship. Their research

examined the achievement gap across multiple countries in Europe and Asia and drew upon data obtained from the Program for International Student Assessment (PISA) in 2009. The measures used to determine socioeconomic status included sub-indices related to home possessions, as found within the PISA data.

2.2. Home Ecology and Reading Achievement

In a more broad-reaching study, Chiu, McBride-Chang, and Lin [7] examined the reading achievement of fourth-grade students from countries around the world from the viewpoint of ecological, psychological and cognitive influencing factors. Chiu et al.'s focus examination of the ecological domain is of greatest pertinence to this study, focusing as it did on both home environment influences and socio-economic status and their influence on reading achievement. These authors examined the number of books in the home as one of the primary ecological variables. The results of their study showed that across most cultures, there is a strong correlation between a lack of economic resources in the home and impeded literacy development. Importantly, Chiu et al. examined the effects of each category of influencing factor at a country level, school level, family level and individual level, and found that within the ecological domain lower levels of reading achievement were more strongly related to country and school level effects than individual effects. From this, they were able to conclude that low reading achievement as a result of environmental factors is most likely to be primarily a societal phenomenon.

Forty-five different regions of the world, encompassing every continent except South America, took part in the Chiu et al. study [7]. A country's gross domestic product (GDP) per capita was used as an independent variable within the ecological domain to give an indication of the socio-economic status of the country, and a significant correlation was found between the economic prosperity of a country, and the levels of reading achievement of its fourth-graders generally. While a great many of the included countries are home to Indigenous cultures and therefore Indigenous learners, the findings of Chiu et al.'s study pertaining to the level of reading achievement in a country should not necessarily be assumed, however, to represent Indigenous learners within that country. It is widely acknowledged and documented that at a global level indigeneity is a powerful predictor of low socioeconomic status [8], and so in these countries, the relationship between the prosperity of the country and the levels of reading achievement are unlikely to hold true for their Indigenous peoples. Hence, since Indigenous learners were not identified and studied separately within each region, conclusions about the reading

achievement levels of Indigenous cultures should not be drawn from country-level results.

2.3. Home Technology and Reading Achievement

Using free lunch eligibility as an indicator of socio-economic status, Hohlfeld, Ritzhaupt, Dawson, and Wilson [9] conducted a longitudinal study in Florida of low- and high-SES schools and the status of the digital divide. This study is of significance for the findings it produced in relation to the difference in both the quality and variety of software available in low- and high-SES schools, as well as the differences evident in the ways in which students from low socio-economic schools use computers compared to those from high socio-economic schools. In particular, students from low socio-economic schools used student-directed software (e.g., communication, organization or productivity tools) less frequently and computer-directed software (e.g., drill and practice software, assessment software) more frequently. It was hypothesized that these differences may relate to these students being disadvantaged in being less able to develop higher order computing skills associated with student-directed software because of a lack of or reduced access to a computer within their homes.

Lubienski and Crane [4] questioned the usefulness of fundamental indicators such as free-lunch eligibility as a determinant of difference in students' socio-economic background when examining academic achievement. Their argument was that a basic variable like free lunch eligibility did not separate out other confounding effects on achievement that can be drawn from a child's home environment. To this end, they examined a broad range of home environment variables to pinpoint factors that predict reading achievement. Variables included ethnicity and number of other children in the home, as well as access to books and computers in the home. These variables were found to be significant predictors of achievement, and the authors discussed the implications for testing systems such as the National Assessment of Educational Progress (NAEP), which relies on student self-reporting on the number of books at home, and which fails to ask how many other children are in the home.

As can be seen from the background literature review for this study, there is a solid history in the literature of research into the influence of non-school environmental factors on the intellectual achievement of children. As far back as the late 1970s, ecological perspectives on child development were emerging from the study of environmental variables and the impact of person-context relationships [2]. More recent studies have shown that across most global regions, there is a strong correlation between a lack of economic resources in

the home and impeded literacy development [7, 6]. This serves to acknowledge the inequalities in academic achievement wrought by social disadvantage. And yet, while the academic achievement of Indigenous children in the United States (Native American, Native Hawaiian, Native Alaskan) has been well researched, the literature shows an emphasis on examining the effect of such variables as racism, self-esteem, language barriers, differing cultural values, attendance, and high mobility [10-12]. There is an apparent lack of attention to whether home ecology factors, especially those pertaining to material resources, also affect reading achievement of Indigenous adolescents.

In order to attempt to in some part address this, the following research questions were developed for this study:

(1) Is having access to a computer in the home related to higher reading achievement in fourth-grade Indigenous students?

(2) Is having various common amenities in the home related to higher reading achievement in fourth-grade Indigenous students?

(3) Is there a relationship between having books in the home and reading achievement in fourth-grade Indigenous students?

Our theoretical framework for this research adopts a scientific inquiry-based approach. The framework was described in great details in The Impact of Conversations on Fourth Grade Reading Performance - What NAEP Data Explorer Tells? [21]. In summary, the research methods combined the inquiry process with scientific knowledge, reasoning, and critical thinking. We started with an extensive exploration of the dataset and that led to the designing of the research questions. The research questions further guided us to mine the data with great in-depth.

3. Methods

To answer these questions, data was drawn from the National Assessment Educational Progress (NAEP) database of reading scores for fourth-grade learners and was analyzed together with variables drawn from NAEP background questionnaires.

3.1. Explanations of NAEP

The National Assessment of Educational Progress (NAEP) is a national measure of trends in academic achievement by elementary and secondary students in the United States. The assessments, which cover a variety of academic subjects, are conducted on a continuous basis every two year. The general uniformity of the assessments used and their repeated

administration over time, allow not only for gaining a snapshot of academic achievement of the nation's students at any given time, but also for gaining an understanding of whether needs exist for educational improvements, or whether progress has occurred on past improvement initiatives.

NAEP is solely a large-group assessment initiative. Information is reported at national, state and regional levels, but not at school or individual levels. Results can also be broken down according to a range of demographic characteristics, such as gender, ethnicity, disability, and so forth.

3.2. The National Indian Education Study

Periodically, there are NAEP special studies conducted, such as the National Indian Education Study (NIES) which explores the educational experience of American Indian/Alaska Native students (AI/AN). Specifically, this study examines and describes the academic performance of this group of students in reading and mathematics at the fourth- and eighth-grade level, as well as their exposure to Native American Culture. The NIES was last conducted in 2015.

3.3. NAEP Background Questionnaires

Additional information is collected at the time the assessments are administered, in order to gather more complete information about the participants. This information is gathered via background questionnaires administered to students, teachers, and schools. Student questionnaires, which are completed by students, gather information on their demographic characteristics, school experiences, and educational support. Teacher questionnaires, which are completed by teachers, gather information teacher training and qualifications, as well as instructional practices. School questionnaires, typically completed by the school principal, gather information on the school characteristics and policies.

3.4. Data for the Present Study

The NAEP Data Explorer for the National Indian Education Study was used to obtain data for this study. All participants in the 2015 sample were identified as AI/AN in-school records and schools with higher proportions of AI/AN students were oversampled. The samples in 2015 were large enough to report results for 14 states. In total there were approximately 15,000 AI/AN students in grades 4 and 8 across the U.S. who participated in the NIES and represented roughly 523,000 AI/AN students nationally or around 1% of total enrolments in public schools [13]. In addition to the background information gathered via the NAEP background questionnaires, further information is gathered from AI/AN

students about their exposure to and knowledge of Native culture and language.

3.5. Selection of Variables

The questions used as variables in this study were drawn from the 2015 NAEP Student Questionnaire and are as follows:

(1) About how many books are there in your home? [Few (0-10); Enough to fill one shelf (11-25); Enough to fill one bookcase (26-100); Enough to fill several bookcases (more than 100).

(2) Is there a computer at home that you use? [Yes; No].

(3) Do you have the following in your home? Fill in ovals for all that apply. [Access to the internet; Clothes dryer just for your family; Dishwasher; More than one bathroom; Your own bedroom].

4. Statistical Analysis

Descriptive tables and tests of statistically significant differences were calculated and presented by Data Explorer [14]. In several instances, the tables were re-formatted without editing the data in the tables. Cohen's d effect sizes [15] were calculated using an online effect size calculator (http://www.uccs.edu/~lbecker/). The definition of Cohen's d effect sizes is a commonly used measure of the size of an effect, where the difference between groups is standardized [16]. It is generally considered amongst researchers that an effect size of 0.50 or larger is considered a significant finding [17].

5. Results

The following statistical analysis results show the average reading scores and standard deviations for AI/AN fourth-grade students nationally. All scores were collected in the year 2015. The results of independent t-tests with an alpha level of 0.05 are also reported, along with effect sizes. Across all of the results, effect sizes ranged from small to medium.

Is having access to a computer in the home related to higher reading achievement in fourth-grade Indigenous students?

The first variable analyzed was whether the student has a computer in the home which he/she uses.

Table 1. Average scale scores for grade 4 reading for AI/AN students, by computer at home, in 2015.

Computer at home	Average scale score	SD
Yes	211	40
No	198	41

Table 1 shows that the average scale scores for those students with a computer at home which they use were significantly higher (p=0.0001). The effect size was small (d = 0.32).

Is having various common amenities in the home related to higher reading achievement in fourth-grade Indigenous students?

The next group of variables relates to whether the student has access to any of the typical home amenities listed in the answer options given. Students were able to select as many of the answer options as applied to them, and it should be noted that there was not an option to answer "no," and so Tables 2, 3, 4, 5 and 6 include scores where no response was given to the answer option.

Table 2. Average scale scores for grade 4 reading for AI/AN students, by access to the internet at home, in 2015.

Internet access at home	Average scale score	SD
Yes	215	38
No	186	42

Table 2 shows that the average scale scores for those students with access to the internet at home were significantly higher (p=0.0000). The effect size was medium (d = 0.72).

Table 3. Average scale scores for grade 4 reading for AI/AN students, by having a clothes dryer in the home, in 2015.

A dryer in the home just for the family	Average scale score	SD
Yes	217	37
No	188	42

Table 3 shows that the average scale scores for those students who have a clothes dryer in a home were significantly higher (p=0.0000). The effect size was medium (d = 0.73).

Table 4. Average scale scores for grade 4 reading for AI/AN students, by having a dishwasher in the home, in 2015.

A dishwasher in the home	Average scale score	SD
Yes	217	38
No	194	42

Table 4 shows that the average scale scores for those students who have a dishwasher in the home were significantly higher (p=0.0000). The effect size was medium (d = 0.57).

Table 5. Average scale scores for grade 4 reading for AI/AN students, by having more than one bathroom in the home, in 2015.

More than one bathroom at home	Average scale score	SD
Yes	216	38
No	192	42

Table 5 shows that the average scale scores for those students who have more than one bathroom in the home were significantly higher (p=0.0000). The effect size was medium (d = 0.60).

Table 6. Average scale scores for grade 4 reading for AI/AN students, by having own bedroom in the home, in 2015.

Have own bedroom at home	Average scale score	SD
Yes	209	40
No	200	43

Table 6 shows that the average scale scores for those students who have their own bedroom at home were significantly higher (p=0.0011). The effect size was medium (d = 0.57). The effect size was small (d = 0.22).

Is there a relationship between having books in the home and reading achievement in fourth-grade Indigenous students?

The final group of variables relates to the home literacy environment and in particular the number of books the students have access to in the home.

Table 7. Average scale scores for grade 4 reading for AI/AN students, by number of books in the home, in 2015.

Books in the home	Average scale score	SD
0-10 books	190	40
11-25 books	203	38
26-100 books	212	39
More than 100 books	220	40

Table 7 shows that the average scale scores for students according to the approximate number of books in the home. Having 0-10 books was significantly lower than 11-25 books (p=0.0002). The effect size was small (d = -0.33). Having 0-10 books was significantly lower than 26-100 books (p=0.0000). The effect size was medium (d = -0.56). Having 0-10 books was significantly lower than more than 100 books (p=0.0000). The effect size was medium (d = -0.75).

Having 11-25 books was significantly lower than 26-100 books (p=0.0237). The effect size was small (d = -0.23). Having 11-25 books was significantly lower than more than 100 books (p=0.0003). The effect size was small (d = -0.44). There was no significant difference between having 26-100 books and more than 100 books (p=0.1269).

6. Discussion

While all of the variables represented home environment factors in some form, it seemed more useful to group them into factors that can be considered direct aids to reading while at home, and factors that are more representative of economic circumstances of the child's family.

6.1. Aids to Reading in the Home

A statistically significant relationship was found between higher reading scores and having access to a computer (p=0.0001) and the internet (p=0.0000) in the home, as well having more than 25 books in the home (p=0.0000). This finding is consistent with previous studies by Molfese et al. [3] who used different measures but found a strong influence of these factors on reading ability in white children, and more recently Lubienski and Crane [4] who eschewed relying on student self-reporting on such things as number of books in the home, but also found the presence of books and computers to be significant predictors of academic achievement.

Similarly, the finding of a relationship between AI/AN students having their own bedroom (p=0.0011) and higher reading scores was consistent with previous research into the effect of having a private space to study within [3], and also indirectly supports Lubienski and Crane's [4] argument that the number of other children the learner must share space with can impact reading achievement.

6.2. Economic Circumsatances

The presence of a clothes dryer or dishwasher in the home and the home having more than one bathroom are all environmental factors that give a relatively reliable indication of the socioeconomic status of the family. Significant relationships were found between all of these elements being present within the home and higher reading scores (for clothes dryer p=0.0000); for dishwasher p=0.0000; for having more than one-bathroom p=0.0000). These findings are consistent with those of Keating and Hertzman [20], Molfese et al. [3], Lubienski and Crane [4], Chiu et al. [7], and Jehangir et al. [6], who all found a relationship between socioeconomic status and academic, or often more specifically, reading achievement.

All of these findings in relation to the economic circumstances and presence of aids to reading in the homes of AI/AN students show that as a cultural group they are in parallel with other cultural groups from around the world for whom low socioeconomic status and inadequate or non-existent access to material resources for learning are having a negative impact on academic achievement [7, 6]. However, in relation to Chiu et al.'s global study of fourth-graders and their reading performance, the results of my study further highlight the issue identified earlier of allowing national findings to represent learners in a country without differentiating their ethnic background. Without doing so, Chiu et al. are able to state that fourth-graders in the United States demonstrate high levels of reading achievement despite the fact that Indigenous fourth-graders in the United States may, by comparison, have levels of reading achievement commensurate with the lower levels of poorer nations.

7. Conclusions and Implications

This study broadly sought to satisfy the question of whether the academic achievement of Indigenous students in the U.S. may be affected by the same detrimental home environment influences as adolescents from other socially disadvantaged cultures. Specifically, the relationship between economic circumstances and material aids to reading in the home and reading achievement was used as a potential indicator of this effect.

7.1. Conclusions and Implications

The results of this study allow us to conclude that there is an evident relationship between home computer access and reading achievement for AI/AN students. As a group, AI/AN fourth-grade students had an average reading scale score of 205 in 2015, which was considerably lower than all students nationally, who had an average reading scale score of 223. As a subset of all AI/AN fourth-grade students, those who indicated that they do have access to a computer at home had a higher average scale score of 211, compared to a score of 198 for those who do not. While this was still considerably lower than the national average, it was a slight improvement on the average score for the overall parent group. This is important because it suggests that further improvement of scores for AI/AN students could potentially be achieved through initiatives that seek to improve access to a computer or mobile device at home or in an after-school programme.

The evidence shows we may also conclude there is a relationship between the presence of common amenities in the home and reading achievement. By extension, we may also conclude that the socio-economic status of the family is likely to be responsible for the lack of these amenities, and therefore probably an important factor impacting reading achievement. As subsets of all AI/AN fourth-grade student, those who indicated that they do have the different amenity types at home had higher average scale scores compared those who do not. Similarly, for each type of amenity, even though the average scale score was still considerably lower than the national average, each score was a slight improvement on the average score for the overall parent group. While a family's economic status is a much more difficult and complex problem to solve than a lack of computer in the home, there are some elements of this category of question that are worthy of particular attention, such as access to the internet, and having a private study space, such as an own bedroom. As well as indicating possible avenues for support and intervention, these findings raise the question of whether this negative relationship is strengthened if, for example, an AI/AN child has no computer or internet at home, as well as no private study space.

Finally, we are able to conclude from these findings that there is a relationship between having a certain number of books in the home and reading achievement in fourth-grade Indigenous students. As a subset of all AI/AN fourth-grade students, those who indicated that they have fewer than 25 books at home had a lower average scale score than all AI/AN students as a whole and a considerably lower average scale score than all students nationally. Of particular note, however, is the result that AI/AN students with more than 100 books in the home had an average scale score of 220, which was virtually on a par with all students nationally (223). The implication of this is that initiatives could be explored that seek to provide more books to low SES Indigenous families. Indeed, the provision of books could be a considerably more viable and economical option for seeking to address poor reading performance in Indigenous students, than the provision of computers or internet-enabled mobile devices.

In light of this evidence, it seems expedient to ask whether enough attention is being duly paid to the learning ecologies of AI/AN adolescents. Given the deficits in reading performance shown in this study, as well the relationship between home environment factors and reading achievement, it would seem there is an evident need for greater attention to be paid to the health of the learning ecologies of AI/AN adolescents in order to identify cases where those affected by social disadvantage are likely also to be achieving academically at a lower standard than their more affluent peers.

7.2. Limitations and Future Research

This study was limited in the extent to which it could also examine the ways in which those AI/AN students who did have material aids to reading in the home used them for learning. While the NAEP background questionnaire on student factors does include questions such as whether the learner uses the internet at home for reading, data was not available from the National Indian Education Study on this particular variable. It is arguably not enough to conclude that having access to a computer or the internet results in higher reading achievement scores when those averages are still significantly lower than fourth-grade students nationally. The question still remains as to what other factors may be keeping those scores lower than they should be, and one of those factors may well be the way in which AI/AN students with computers or the internet make use of them. Research has already been done on the notion of technology as a deliverer of literacy to young learners. Burnett [18] in the United Kingdom made a study of the relationship between engagement with digital texts in educational settings, and the digital practices of children within their own homes. She conjectured that an in-depth analysis of these two areas could help explain "polarities" associated with the literacy of children from different backgrounds if it is better understood how technologies disrupt or reinforce the development of literacy. Likewise, Harris, Straker, and Pollock [19] paid specific attention to the purposes behind computer use by Western Australian students from low socio-economic backgrounds. In their study, they found that students in low socio-economic neighborhoods had higher levels of use of both computers and other electronic devices (e.g., mobile phones, TV, electronic gaming systems) than high socio-

economic neighborhoods, but were found not to be using the technologies for educationally focused activities.

Further research appears warranted into identifying the nature, strength, and health of the learning ecologies that Indigenous students are typically able to develop around themselves. Issues of access to material aids are just one factor within the many that can impact reading achievement and help determine a learning ecology. More needs to be known about these factors, as well as whether combinations of these ecological factors are in fact compounding the problem. Furthermore, research is needed into the possible effects of interventions that could not only seek to provide greater equity of access for Indigenous students to material aids that higher socioeconomic learners may take for granted, but also interventions that could potentially improve the health of their learning ecologies.

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