1. Title

Student Well-Being and Reading Achievement: A Profile-Based Analysis of U.S. Students

2. Abstract

Student well-being is a critical factor influencing educational outcomes. cite Previous studies have highlighted the importance of school belonging, academic self-concept, and bullying in shaping students' well-being and academic achievement. cite However, little is known about how variations in well-being indicators predict students' academic success. Using a nationally representative sample of 4th graders from the PIRLS 2021 dataset, this study investigates (1) whether different student profiles exist based on well-being indicators and (2) how the profile membership predicted students' reading achievement.

Latent Profile Analysis identified three distinct groups based on four well-being indicators: sense of school belonging, bullying experiences, feelings of tiredness or hunger, and absenteeism. Profile 1, with high absenteeism, tiredness, hunger, and bullying, and the lowest school belonging to, showed the poorest reading performance. Profile 2, with moderate well-being and school belonging, lower absenteeism, and reduced bullying, performed better than Profile 1 but less well than Profile 3. Profile 3, with the highest well-being, strongest school belonging, and least bullying, achieved the best reading outcomes.

These results suggest a clear link between a positive school environment and improved academic performance. The findings emphasize the need for schools to reduce bullying, foster inclusivity, and address students' basic needs, such as hunger and tiredness. By improving student well-being, educators and policymakers can enhance academic outcomes. Our future research will build on these results by comparing patterns across different countries to identify effective, globally relevant practices.

3. Introduction

Children in the United States are still recovering from the emotional and social disruptions brought on by the COVID 19 pandemic. A recent national study reported that U.S. students continue to experience elevated levels of emotional distress and decreased school engagement, even as in-person learning has resumed (Santucci et al., 2024). These findings express a new realization: academic achievement cannot be fully understood or improved without attending to student wellbeing.

Among the many dimensions of wellbeing, factors such as school belonging, experiences of bullying, and academic confidence have received increasing attention for their role in shaping students' learning trajectories (Ruppel, 2015). However, large scale studies often examine these variables in isolation, overlooking how they interact within students lived experiences. Understanding how these factors interact with each other is essential for developing policies and strategies that focus on students' mental health.

Self Determination Theory (Ryan & Deci, 2022) provides a useful framework for conceptualizing how well-being supports learning. According to the theory, optimal development and motivation stem from the fulfillment of three psychological needs: autonomy, competence, and relatedness. Within school contexts, these needs map onto constructs such as student confidence (competence) and school belonging (relatedness). When these needs are met, students are more likely to engage meaningfully with academic content and perform at higher levels.

At the same time, Bronfenbrenner's Ecological Systems Theory (Guy-Evans, 2024) offers a broader perspective, emphasizing how students' experiences are shaped by intricated systems from family and peers (microsystem) to school policies and societal stressors like the pandemic (macrosystem). Together, these frameworks highlight the importance of examining both internal needs and external contexts in understanding student learning.

Despite this evidence, few studies have used a person-centered approach to examine how these variables interplay within each other and how it impacts students' lives. To address that gap, this study uses PIRLS 2021 data, collected during the pandemic recovery period, when schools were still dealing with the effects of remote learning, student anxiety, and disruptions in peer relationships. By using Latent Profile Analysis, our goal is to identify wellbeing profiles among U.S. fourth graders and analyze how these profiles relate to reading achievement to understand how social emotional experiences interact to shape academic outcomes.

This research is guided by the question: To what extent do students' well-being, sense of school belonging, and experiences of bullying predict reading achievement in the United States? Specifically, we aim to (1) identify distinct student profiles based on well-being indicators, and (2) examine how these profiles relate to reading achievement outcomes. Guided by Self-Determination Theory, Ecological Systems Theory, and prior research, we hypothesize that multiple well-being profiles will emerge and that students in profiles reflecting higher well-being will exhibit stronger reading achievement. By uncovering these patterns, the study aims to provide insights that can inform more supportive, equitable, and effective educational practices.

4. Method

a. Participants

For this project we used data from the Progress in International Reading Literacy Study (PIRLS) 2021, focusing on fourth grade students in the United States. PIRLS bases its sampling on a two-stage stratified design. In the first stage, schools are selected with probability proportional to size (PPS) based on enrollment. In the second stage, one or more random fourth grade classrooms are selected within each sampled school to participate in the study.

Stratification variables included school type, public vs private, geographic region, urban vs rural, and other factors as specified in the U.S. national sampling documentation. The dataset includes PSU (Primary Sampling Unit) and STRATUM variables to account for

complex sampling. Jackknife replication zones (JKZONE) and replicate weights (JKREP) are used for valid variance estimation.

However, due to COVID-19 related disruptions, PIRLS 2021 data collection was delayed by one year in many participating countries, including the United States. As a result, most students were assessed in fifth grade rather than fourth grade. Additionally, while PIRLS 2021 introduced a new digital, paperless assessment format, the U.S. primarily administered the paper-based version due to logistical constraints during the pandemic. To maintain consistency and reduce the burden on schools, the U.S. National Center for Education Statistics (NCES) opted to conduct the assessment with students in grade 5 in 2021 instead of retroactively testing fourth-grade cohorts.

The U.S. PIRLS 2021 dataset initially included 1,657 students across 78 schools, comprising 801 boys and 855 girls. After data cleaning procedures like removing cases with missing responses on key variables, the final sample consisted of 1,255 students.

b. Variables

This study includes one primary dependent variable, several grouped independent variables, and relevant covariates, all drawn from the PIRLS 2021 student context questionnaire.

Dependent variables like reading scores, assessed using plausible values representing students' reading literacy scores, international Benchmark scores comparing them to the other countries that participated in the study.

Independen Variables that we grouped into three well-being domains, to have a better understanding of what each one tells us, physical and Emotional wellbeing, school belonging and bullying experiences, as well as a school belonging and student wellbeing scale.

Covariates or moderating variables like gender, age, language spoken at home, to see if they will also play a role on differentiating their wellbeing stages or be impartial

To ensure population-level inference, analyses applied the TOTWGT student weight variable. Jackknife replication (using JKZONE and JKREP variables) was employed to estimate standard errors that account for the complex sampling design. Data processing and analysis were conducted using R (with the edsurvey package) and SPSS (with IDB Analyzer).

5. Analysis Plan

Data was cleaned and standardized prior to analysis. Descriptive statistics were first computed to summarize the distributions of well-being indicators (school belonging, bullying, tiredness/hunger, and absenteeism) and reading achievement scores.

Latent Profile Analysis (LPA) was then conducted using **R** (package *mclust*) to identify subgroups of students with similar well-being characteristics. Models specifying two

to five latent profiles were estimated. Model fit was evaluated using the Bayesian Information Criterion (BIC), sample-size adjusted BIC, and entropy values, with the best-fitting model determined based on both statistical indices and substantive interpretability.

After assigning students to their most likely profile, mean reading achievement was compared across profiles. To account for PIRLS' complex sampling design, analyses incorporated student weights (TOTWGT) and jackknife replication (JKZONE, JKREP) for variance estimation. A one-way Analysis of Variance (ANOVA) tested for overall differences in reading scores among profiles. Significant effects were further examined with **Tukey's Honest Significant Difference (HSD)** tests to evaluate pairwise profile comparisons.

6. Results

Latent Profile Analysis (LPA) identified three distinct student profiles based on indicators of school belonging, bullying, tiredness/hunger, and absenteeism.

Profile 1 (Low Well-being & Belonging, High Bullying): Students in this group reported the highest levels of absenteeism, tiredness, and hunger, combined with low school belonging and elevated experiences of bullying.

Profile 2 (Moderate Well-being): Students in this profile reported better well-being and lower bullying compared to Profile 1, but still lower well-being than those in Profile 3.

Profile 3 (High Well-being & Belonging, Low Bullying): This group reported the lowest absenteeism, hunger, and tiredness, along with the highest levels of school belonging and the fewest experiences of bullying.

Model fit indices (BIC, aBIC, and entropy) supported the three-profile solution as the most parsimonious and interpretable.

Reading Achievement Across Profiles

A one-way ANOVA revealed a statistically significant difference in reading achievement across the three profiles, $\mathbf{F(2, 1280) = 69.13, p < .001}$.

Post-hoc comparisons using Tukey's HSD test indicated:

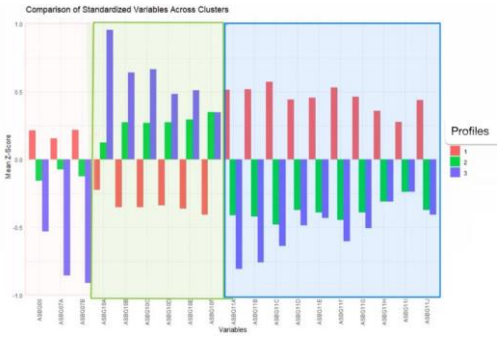
Profile 1 students scored significantly lower in reading than both **Profile 2** ($p < .001$) and **Profile 3** ($p < .001$).

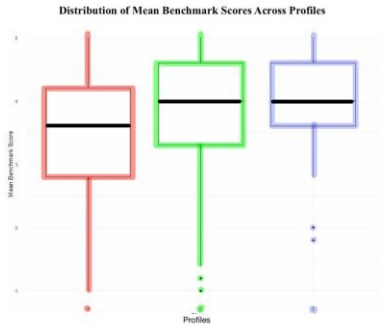
There was **no statistically significant difference** between the reading scores of **Profiles 2 and 3** ($p = .30$).

Summary of Findings

Overall, students with the most favorable well-being indicators (Profile 3) demonstrated the strongest reading achievement, while those with the least favorable

indicators (Profile 1) exhibited the poorest outcomes. This supports the hypothesis that higher well-being is associated with improved academic performance.





7. Discussion

The present study examined how variations in student well-being—captured through indicators of school belonging, bullying, tiredness/hunger, and absenteeism—relate to reading achievement among U.S. students in PIRLS 2021. Latent Profile Analysis revealed three distinct groups that differed meaningfully in both their well-being experiences and reading outcomes.

Profiles characterized by stronger school belonging, fewer experiences of bullying, and lower levels of tiredness and absenteeism demonstrated significantly higher reading performance. This pattern aligns with Self-Determination Theory (Ryan & Deci, 2022), which emphasizes the role of competence and relatedness in supporting optimal learning. Students with a high well-being profile likely experienced stronger feelings of relatedness through school belonging and reduced negative peer interactions, enabling them to engage more fully with academic content. Similarly, Ecological Systems Theory (Bronfenbrenner, 1992) suggests that proximal environments, such as peer relations and classroom climate, play a critical role in shaping academic outcomes. Elevated bullying and absenteeism in the low well-being profile highlight how adverse microsystem conditions can hinder learning opportunities.

These findings reinforce earlier evidence linking student well-being to academic achievement. For instance, Rüppel et al. (2015) found that psychological well-being significantly predicts academic success, while Tan et al. (2022) showed that school belonging exerts a positive effect on reading literacy. Similarly, Huang (2022) demonstrated that bullying negatively affects students' academic performance, with belonging mediating this relationship. The current study contributes to this literature by applying a person-centered approach, demonstrating that these well-being indicators cluster into distinct profiles that map onto predictable academic outcomes.

The results carry important implications for educators and policymakers. Efforts to reduce bullying and foster inclusive, supportive school climates may yield direct benefits for academic achievement. Likewise, addressing students' basic needs through school meal programs and initiatives targeting tiredness and absenteeism can help level the playing field for vulnerable groups. Integrating social-emotional learning (SEL) curricula that promote

belonging and resilience may further strengthen students' psychological resources for learning.

Several limitations warrant caution. First, the study relies on self-reported questionnaire data, which may introduce bias. Second, the cross-sectional design precludes causal claims about the direction of the well-being–achievement relationship. Third, while the analysis accounted for the complex sampling design, cultural and contextual factors unique to the U.S. may limit generalizability to other settings.

Future studies should build on these findings by conducting cross-national comparisons to assess whether similar well-being profiles emerge across countries with different educational systems. Longitudinal designs would help establish causal pathways between well-being and academic outcomes, while incorporating teacher- and classroom-level variables could provide a more comprehensive ecological perspective. By extending this line of inquiry, researchers can better inform interventions aimed at promoting both student well-being and academic success.

8. Conclusion

This study shows a strong link between student well-being, school belonging, bullying experiences, and reading achievement. Schools aiming to improve academic outcomes should focus on reducing bullying, building inclusive environments, and supporting students' physical and emotional well-being. Future research will expand on these findings by examining cross-national patterns to inform global educational practices.

9. References

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