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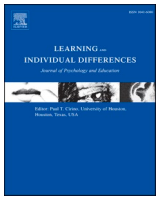

The role of teacher support in students' academic performance in low- and high-stakes assessments

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ABSTRACT

Teachers' impact on learning outcomes is well supported, but more robust evidence is needed on the complex indirect pathways through which teacher support impacts performance in low-versus high-stakes examinations. This study sought to understand the divergent mechanisms through which teachers' support for students affects their performance on low- and high-stakes assessments. Bayesian structural equation modeling with the Markov Chain Monte Carlo algorithm and data from Ghana were used to test mediated, unmediated, and moderated-mediated relationships. The results show that a typical student's high-stakes exam performance increases by approximately 13 % for each one-unit increase in teacher support. A chain mediation effect also exists through student homework behavior and low-stakes everyday performance. Student gender is also a moderator. These results could aid in identifying the malleable leverage points associated with low- and high-stakes assessments. Such empirical clarity would help education administrators to develop appropriate professional development programs that enhance teachers' support roles, enabling them to respond better to learning disparities and related challenges.

0. Educational relevance statement

- This study fosters discussions and dialogue on collaboration between teachers and parents in supporting students, particularly concerning their low-stakes formative tasks, such as homework assignments.
- This study is crucial for assisting school administrators in implementing strategies to enhance students' learning experiences by focusing on assessment methods and daily formative processes.
- This study inspires future research into how teacher support can improve students' academic performance.
- This study aims to provide additional insight into how students can enhance their performance on low-stakes formative assessments to improve their performance on high-stakes summative evaluations.

1. Introduction

Teachers' support role, in its varied forms, is integral to fostering student learning and academic advancement. More concrete evidence is required to clarify the complex and indirect pathways through which teacher support affects student academic performance. This study explores the direct and indirect ways in which teachers' influence contributes to students' performance on two different but related assessments (low- and high-stakes exams), with the goal of fostering further discussion on how teachers can better support their students. Insights from this study could draw attention to teachers' roles in inculcating good learning behaviors in students through their daily school activities, all of which contribute to their achievement of long-term educational outcomes. Teacher support studies tend to measure student learning outcomes using only high-stakes summative assessments such as final exams (Bonney et al., 2015; Glozah & Pevalin, 2014;

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Peng et al., 2022). Such studies rarely analyze assessments of everyday schooling activities, even though student performance on high-stakes summative exams depends partly on low-stakes formative assessments (e.g., homework and in-class exercises). Failure to account for both low- and high-stakes exams could limit researchers' and educationists' holistic understanding of how students' academic performance can be improved. Thus, this study draws attention to the often-underemphasized role of student performance in formative assessments to better understand how teacher support affects student learning processes and outcomes. We juxtapose the direct influence of teacher support on student performance in summative assessments (i.e., high-stakes final exams) with indirect chain mediation effects through student behavior (e.g., homework habits) and performance on formative assessments (e.g., low-stakes daily school exercises).

The present study advances the understanding of empirically documented pathways between teacher support and student learning outcomes by building on studies that specifically assessed the impact of teacher support on student classroom engagement (Ansong et al., 2017), homework behavior (Alhassan et al., 2017; Xu et al., 2022), and performance trajectories in selected subject areas (Ansong et al., 2020). Our findings can strengthen the evidence on *whether* and *how* teacher support for students differentially or uniformly accounts for performance on both low- and high-stakes examinations at the junior high school level.

2. Background

2.1. Teacher support

Teachers are crucial agents in the school system. By providing students with informational, instrumental, emotional, and appraisal support, teachers can provide instruction and create an environment conducive to student learning (Lei et al., 2017). Indeed, teachers are well documented as essential actors that drive students' psychological, behavioral, and achievement outcomes (Ansong et al., 2017; Crisler, 2015; Roorda et al., 2011). Several Global North and South studies have shed light on how teachers' relationships with students support their mental health and psychosocial well-being, including overall happiness, low depression, high self-esteem, and greater emotional engagement (Ansong et al., 2017; Lenzi et al., 2017). Furthermore, studies on teacher support for students have shown that such support can trigger positive school-related behaviors and attitudes favorable to student success, including behavioral engagement (Alhassan et al., 2017; Ansong et al., 2017; Skinner et al., 2008). A meta-analysis by Lei et al. (2017) found an association between teacher support and students' academic emotions. However, the strength of this relationship varies geographically, with European and American students exhibiting stronger associations than East Asian students do. Given the well-documented impact of teacher support on students' behaviors and emotions, it is evident that such support fosters conducive learning environments that enable increased academic achievement. However, the magnitude of this relationship remains unclear in most African countries. A lack of concrete empirical knowledge of the nature and scope of this relationship may hinder interventionists and educators from formulating effective solutions in the African context.

In addition to empirical evidence from prior studies, social support theory provides a theoretical basis for the role of teachers in fostering student outcomes. This theory postulates that the core aspects of social support (e.g., appraisal, emotional, informational, and instrumental support) can reduce delinquency and other negative behaviors (Lam, 2019; Siu et al., 2023), which may be detrimental to student outcomes. Social support theory also emphasizes the impact of significant others (in this case, teachers) in helping students create a positive identity and develop positive relationships with their peers (Heller et al., 1986). Beyond providing emotional support, teachers are expected to treat their students with empathy, care, and love, which will help to build trust between students and teachers in school settings. The instrumental support teachers provide for their students includes dedicated and supplemental tuition support or other incentives to encourage them and instill positive behavior. These forms of teacher support may trigger an emotional or behavioral response in students before affecting their academic performance, suggesting that an indirect linking mechanism or a mediator operates in this pathway.

However, there are empirical gaps in how and the extent to which teachers' wide-ranging support, particularly instructional, emotional, and equity and inclusion support, affects students' learning behavior, day-to-day learning outcomes in school, and long-term learning growth. A rich body of scholarship has shed light on the various contributions of teachers to student academic and behavioral outcomes (Ansong et al., 2017; Appiah-Kubi & Amoako, 2022). However, little evidence exists on the connections between the different dimensions of teacher support and formative performance (e.g., homework behavior and day-to-day learning outcomes), particularly at the junior high school level. Consequently, this study investigates how teachers' support of students—primarily instructional, emotional, and equity and inclusion support—directly contributes to improvements in students' homework-related behavior and day-to-day (i.e., formative) learning at the junior high school level. Further, the study sheds light on how such improvements boost junior high school students' overall performance in summative assessments, often administered as high-stakes exams taken at the end of an academic program.

2.2. Student behavior as a mediator

Research suggests that changes in student behavior resulting from teachers' support for students may significantly mediate the relationship between teacher support and student academic performance (Affuso et al., 2023; Chamizo-Nieto et al., 2021; Malecki & Demaray, 2003). However, prior research has not clearly articulated and assessed the mechanism linking teacher support to homework practices and learning outcomes, particularly in under-resourced and rural schools. A deeper understanding of these pathways will allow researchers and interventionists to identify the critical malleable factors and leverage points to enable effective early interventions that address learning needs, gaps, and challenges among students in under-resourced countries, such as Ghana.

When students exhibit disruptive behavior, teachers are often the school's frontline interveners responsible for checking, managing, and regulating student behavior in the classroom (Ryan et al., 2003; Simonsen et al., 2008). Evidence shows that negative student behaviors create an unconducive school climate (Alonso-Tapia & Ruiz-Díaz, 2022; Nooruddin & Baig, 2014), whereas positive student behaviors promote a healthy classroom and school environment (Hopson & Lee, 2011) and enhance academic performance (Durlak et al., 2010). Thus, managing student behavior is essential for maintaining a school environment that is conducive to student learning and academic and socio-emotional growth (Sharma, 2016).

Adverse student behaviors that may be detrimental to their academic success include failing to take homework seriously, nonconformity, a lack of respect for authorities, and bullying. This study specifically focuses on students' academic activities related to homework assignments. In many sub-Saharan African contexts, student performance on homework tasks is a primary component of formative assessment, meaning that homework is a significant determinant of students' academic performance (Cooper & Valentine, 2001). In addition to serving as a performance indicator, homework cultivates students' time management skills (Xu, 2006), teaches commitment to task completion, and builds students' capacity to manage their academic work independently from the teacher. The current study focuses on the academic performance effects of teachers' support on students' homework behavior (i.e., obtaining, completing, and turning in homework assignments correctly). We aim to assess how teachers contribute to students' learning processes and behaviors (i.e., everyday low-stakes formative

assessments and homework tasks) and how they, in turn, translate into students' performance on high-stakes summative exams. We test the hypothesis that student homework-related behavior is a potential intervening factor that helps link teacher support to improved academic performance among junior high school students.

This study also examines how student gender moderates the relationships between teacher support and formative and summative exams. We consider gender as a potential moderator because gender dynamics are associated with students' attitudes toward homework. Namely, the differential socialization of various genders across societies influences children's ability to devote time to academic work outside school (Eschenbeck et al., 2007; Kitsantas & Zimmerman, 2009). While girls may have more household chores, boys, on the other hand, are more likely to engage in intense errands (Bruckauf & Rees, 2017), which could impact the time devoted to homework. Studies have established that boys exhibit adverse and disruptive attitudes toward homework (Hong et al., 2011; Xu, 2006). The current study's incorporation of gender into statistical modeling will account for possible gender-driven heterogeneity in the relationship between homework behavior and formative and summative academic performance.

2.3. Performance in formative assessment

A distinguishing characteristic of this study is its focus on student academic performance throughout an academic term (i.e., at the formative stage) rather than exclusively focusing on the final exam (i.e., at the summative stage). Traditional reliance on formative assessments is grounded in the idea that lower-stakes interim assessments enable teachers, students, and even parents to monitor students' day-to-day progress and provide ongoing feedback throughout an academic term or year (Carrillo-de-la-Peña & Perez, 2012; Samson & Marongwe, 2013). For teachers, appraisal support (e.g., formative assessment feedback from administrators and students) informs everyday teaching adjustments to better support student learning (Graham et al., 2015). Graham and colleagues observed that, like teachers, many students monitor their performance on formative assessments and adjust their learning behaviors accordingly. Parents and guardians are often interested in formative assessments because these interim assessments help them track their children's day-to-day performance, enabling them to intervene when necessary. For instance, in Ghana, many parents enroll their children in afterschool supplemental tutoring because of concerns about their children's mediocre performance trajectories (Ansong et al., 2023).

Several studies have highlighted positive associations between student performance on formative assessments (i.e., day-to-day schoolwork) and summative assessments (i.e., final exams). Recently, Demaku and Xhaferi (2021) found that formative assessment scores (sometimes called *continuous assessments*) predicted students' academic performance. Similarly, a study in Northern Ireland found that formative assessment is instrumental in encouraging students to continue learning throughout the semester, significantly impacting their final exam scores (Cole & Spence, 2012). In Nigeria, Bichi and Musa (2015) established that formative assessment performance is a strong predictor of success on final exams. Moreover, Graham et al.'s (2015) meta-analysis of 27 studies identified positive effects of formative assessment on the writing abilities of elementary school students when they used feedback from these assessments to inform their learning behavior. The fact that these studies, conducted in diverse settings, reached similar conclusions makes a compelling case for the importance of formative assessments to overall academic performance.

Notwithstanding the literature supporting a greater focus on student performance in formative assessments, a few studies have found fewer compelling effects of formative assessments on student academic outcomes at the summative stage. For instance, Reboredo (2016) found that formative assessment barely contributed to higher final exam scores. Notably, this study was conducted among undergraduate students, representing a vastly different population from the literature reviewed in this study. In a meta-analysis of 27 studies by Graham et al. (2015), five found positive but weak effects of teachers' use of formative assessments on student performance. Such weak findings may indicate that the impact of formative assessments on summative assessment performance may depend on the level of education or the subject of interest, both of which varied across the 27 studies analyzed. Furthermore, the lack of proper and harmonized formative assessment measures may also account for the seemingly weak or mixed relationship (Abdur-Rafiu et al., 2020; Abejehu, 2016), suggesting the need for more studies that use trusted and compatible measures. We exclusively focused on junior high school students to control for differences across education levels. We also expand the outcome variable to include student performance on all academic subjects that students are tested on at the junior high school level (i.e., mathematics, science, English language, social studies, information and communication technology [ICT], basic design and technology [BDT], and religious and moral studies [RME], and Ghanaian language) because of their relevance to academic progress.

Gender dynamics may also differentially affect students' performance in everyday academic work. Overall, boys and girls have been shown to benefit from the academic enhancement effects of formative assessments. For instance, in an all-female sample from Pakistan, Iqbal and Anjum (2017) found positive effects of everyday academic performance on girls' elementary school final exams. However, in socially conservative cultures, where gender roles are more strictly defined and enforced, certain chores may compete with the amount of time girls or boys spend on homework during afterschool hours (Alhassan et al., 2017). Alhassan et al. found that Ghanaian boys devoted about 15 min more than girls to schoolwork during afterschool hours. Day et al. (2018) found that formative assessment effectively improved first-year male law students' overall academic success compared with their female counterparts. Given previous evidence of such gender-based differences, this study hypothesizes that the differential effects of gender roles manifest in differences in homework behavior and formative academic performance.

2.4. The current study

Based on the extant empirical gaps, the current study addresses three questions, and the corresponding hypotheses are illustrated in Fig. 1. *Question 1*: How much does teacher support differentially contribute to improving students' day-to-day learning outcomes and overall performance at the end of their academic program? We hypothesize a direct relationship between teacher support for students and improved academic performance in low-stakes (H_{1a}) and high-stakes (H_{1b}) assessments. We address this hypothesis by specifying and testing unmediated links between teacher support and student performance on low- and high-stakes assessments. *Question 2*: To what extent is the predictive role of teacher support in formative and summative performance transmitted through student homework behavior? We build on the prior hypothesis by specifying and testing a mediated relationship between teacher support and student performance, with student homework behavior playing an intervening role (H_2). *Question 3*: Does the magnitude of the mediated relationship depend on students' gender? We specify and test a hypothesis that suggests a moderated mediated relationship, whereby teacher support interacts with students' gender to produce differential effects on academic performance (H_3).

Answering these questions will contribute to the existing literature, which could help teachers and education interventionists appropriately balance and prioritize summative exams (e.g., final exams) and formative assessments (e.g., homework assignments). Additional studies of this nature can augment the existing body of evidence, especially in conservative-leaning and resource-limited contexts, by providing valuable insights for researchers and educators seeking a deeper understanding of student performance trends and sources of student performance deficits. In addition, empirically tracing the pathways through which teacher support relates to a broad range of students'

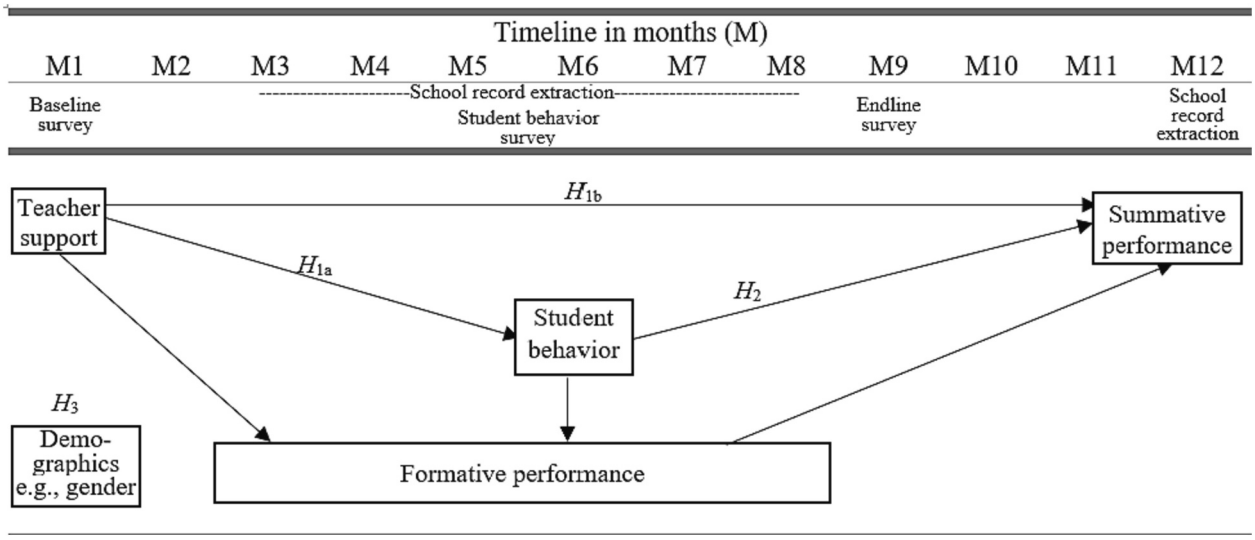

Fig. 1. Illustration of the hypothesized model vis-à-vis the data collection timeline.

everyday performance indicators and summative performance could add to the repository of knowledge that may inform effective programming and policy responses that boost student outcomes. Ultimately, educators and stakeholders in conservative-leaning educational contexts like Ghana would benefit from empirical insights into whether efforts to boost formative assessment performance may translate into student success indicators.

3. Methods

3.1. Data source

This study used data from a research project in three public junior high schools in Ghana's Ashaiman and Dangme West administrative districts. In the three schools, 135 of the approximately 150 final-year students agreed to participate in the study. Three types of data were collected: Two survey data were collected from student participants nine months apart, and teachers used data abstraction forms to extract student academic performance scores from school administrative records. Teachers completed a separate survey before the last student survey to share their assessment of each student's homework behavior. Parental consent and children's assent were sought for students under 18 years, while the handful older than 18 provided their consent. The Ghana Education Service district offices and the University of North Carolina-Chapel Hill Institutional Review Board (IRB 14-1475) pre-approved all research protocols.

3.2. Measures

3.2.1. Teacher support

The main antecedent variable, teacher support, was measured at baseline using four items: (a) When I need extra help, I can get it (i.e., instructional support); (b) My teachers are interested in me as a person (i.e., emotional support); (c) Our teachers are nice and friendly (i.e., emotional support); and (d) Our teachers treat us fairly (i.e., equity and inclusion support). The response set used a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale was previously validated in a study with the same population (Ansong et al., 2017); thus, we constructed a teacher support composite score as a data reduction approach. This approach reduces information overload and retains statistical power (Doan et al., 2019; Song et al., 2013), which is particularly useful given this study's relatively small sample. However, to verify the adequacy of the scale, a measurement-only model was assessed prior to constructing the composite score. The model revealed that the items had acceptable factor loadings (i.e., 0.43 to 0.63) and a good fit ($\chi 2 = 3.65$, df $= 3$, $p < .001$, CFI $= 1$, TLI $= 0.96$), with a relatively low but acceptable Cronbach's alpha ($\alpha = 0.67$; Taber, 2018).

3.2.2. Academic performance

Two junior high school-level academic performance variables, formative and summative academic performance, were modeled in this study. *Formative performance* is a continuous variable initially measured on a 50-point scale that evaluates students' performance in daily schoolwork, homework, and class exercises during the 15-week academic term. *Summative performance* is a continuous variable on a 9-point scale measuring students' academic performance on end-of-program exams that students take after three years in junior high school. Students sat for this exam after completing the endline survey. Both performance variables focus on the eight subjects that junior high students are taught and tested on in Ghana: mathematics, science, English language, social studies, ICT, BDT, RME, and Ghanaian language.

The proportion of maximum scaling (POMS) method employed with the same data in a prior study (Ansong et al., 2020) was used to rescale the formative performance variable in the current study into a 9-point scale to align with and improve the comparability of the two performance measures. Following standardization, the eight academic subjects were aggregated into two separate composite scores for both formative and summative performances.

3.2.3. Homework behavior

Student homework behavior is measured using a three-item student homework behavior construct. Using a 9-point response set anchored at 1 (never), 3 (seldom), 5 (sometimes), 7 (usually), and 9 (always), the class teacher responded to the following statements about each student participant: (a) Turns in completed homework on time; (b) Takes all work materials home that are required for his/her homework assignment; and (c) Writes down homework assignments correctly and completely. These items were adopted from the Behavior Report Card (Wright, 2004) and were administered before the endline survey.

3.2.4. Gender

Student gender serves as a moderator and is a binary variable, with 1 denoting female and 0 denoting male. The measurement occasions for each variable examined in BSEM are shown in Fig. 1.

4. Analysis

4.1. BSEM analysis and selection of final model

To leverage the findings from prior studies, we used Bayesian structural equation modeling (BSEM) with the Markov Chain Monte Carlo (MCMC) algorithm to evaluate the structural relationships among teacher support, student behavior, and [formative and summative] academic performance. We also assessed moderated relationships, focusing on students' gender and interactions with teacher support. All models used 50,000 interactions, two chains, and the Gibbs sampler (Asparouhov & Muthen, 2010). Mplus 8.7 was used for all statistical analyses.

BSEM uses a mix of non-informative and informative priors. Priors for correlated errors in the measurement part of the model were specified as N(0,1). Informative priors [~N(0.86, 0.02)] were specified for the association between teacher support and academic performance, based on the findings of a meta-analysis by Graham et al. (2015). We also modeled informative priors for the relationship between teacher support and student behavior [~N(0.09, 0.05)] based on Strati et al.'s (2017) findings. We used non-informative defused priors, the default in Mplus, for the remaining parameters.

4.2. Model fit

We assessed model convergence based on whether the potential scale reduction factor (PSRF) was close to 1 and ideally <1.1 (Gelman et al., 2014; Kaplan & Depaoli, 2012). We used the posterior predictive *p*-value (PPP) to assess the model's fitness, where values above 0.1, an acceptable fit, and close to 0.5, suggest a great fit, and values close to 0.05 or less suggest a poor fit. The higher the value, the more probable it is that the observed data are comparable to the generated data (Zyphur & Oswald, 2015). In addition, the 95 % confidence interval for the difference between the observed and generated chi-square values should ideally be small, with a negative value for the lower limit and a positive value for the upper limit. Additionally, we expected the posterior predictive checking distribution plot to be centered around the center of the histogram and a fit line running through the posterior predictive scatterplot.

5. Results

5.1. Descriptive statistics

Table 1 shows the average scores of the four variables of interest—teacher support, student homework behavior, and formative and summative academic performance—and the moderator, gender. The mean score for the standardized composite teacher support variable was <0.0002 (SD = 0.78). Comparatively, the teacher support score was lower for girls (M = −0.07, SD = 0.72) than for boys (M = 0.09, SD = 0.84), although the difference was not statistically significant (p = .25). The average performance score was 4.77 (SD = 1.95) for the formative assessment and 2.94 (SD = 2.83) for the summative assessment. Boys slightly outperformed girls, although the difference was only statistically higher at the formative level ($p < .01$). The three student behavior scores averaged 6.23_{HB1} (SD = 1.60), 6.87_{HB2} (SD = 1.72), and 6.88_{HB3} (SD = 1.79). We observed no gender differences in homework behavior except that boys were more likely than girls to take home required materials for homework assignments (M_{boys} = 7.33, SD = 1.42; M_{girls} = 6.47, SD = 1.87; t = 2.74; $p < .01$) and to write down homework assignments correctly and completely (M_{boys} = 7.56, SD = 1.42; M_{girls} = 6.36, SD = 1.93; t = 3.73; $p < .001$). The overall sample's average age was 16 years (SD = 1.81), with boys slightly older than girls (M_{boys} = 16.33, SD = 1.76; M_{girls} = 15.72, SD = 1.82; t = 1.85; p = .07).

Table 1
Summary statistics.

Variables	Overall sample		Boys sample		Girls sample		*t*-test *p*-values
	Mean	SD	Mean	SD	Mean	SD	
Teacher support score (transformed)	<0.002	0.78	0.09	0.84	−0.07	0.72	0.25
Student age	16.00	1.81	16.33	1.76	15.72	1.82	0.07
Formative performance	4.77	1.95	5.49	1.71	4.52	1.65	0.01
Summative performance	2.94	2.83	3.07	2.71	2.64	2.81	0.40
Turns in homework on time (HB1)	6.23	1.60	6.52	1.48	6.02	1.73	0.10
Takes homework materials home (HB2)	6.87	1.72	7.33	1.42	6.47	1.87	0.01
Records homework assignments correctly and completely (HB3)	6.88	1.79	7.56	1.42	6.36	1.93	0.001

5.2. Model fit

The BSEM showed an acceptable model fit. First, at 600 iterations, the model reached a PSRF of 1.01 (below the 1.1 threshold), suggesting model convergence. Second, the PPP of 0.419 well exceeded the 0.1 minimum threshold and was close to the ideal 0.5 value, suggesting a good model fit. Third, the 95 % CI for the difference between the observed and replicated chi-square values contained 0 (i.e., [−17.24, 20.06]), confirming a good model. Moreover, visual inspection of the posterior parameter trace plots, posterior predictive scatterplot, autocorrelation plots, and predictive checking distribution plots confirmed the model convergence and acceptable model fit.

5.3. Bayesian SEM results

Fig. 2 shows the results of the proposed model with teacher support directly predicting end-of-year academic performance and indirectly predicting it through the mediation role of student homework behavior and performance on daily schoolwork. All measurement paths (factor loadings) and structural paths were significant at the 5 % level, except for the paths from teacher support to daily academic performance and from student homework behavior to end-of-year academic performance. Next, we unpack these results and report the posterior mean point estimates and the 95 % credible intervals (CI).

5.3.1. Teacher support

Teacher support significantly predicted end-of-year academic performance through two pathways. The first pathway is a direct positive association between teacher support and end-of-year academic performance (mean coefficient [$_{\mu}\beta$] = 0.37; posterior standard deviation [PSD] = 0.16; $p < .01$). For instance, if a teacher's support for a student improves to a point where a student who previously offered a *neutral* response about their teacher's support now says they agree that the teacher supports them, that student's performance on the high-stakes exam could increase by 13 % (i.e., [0.37*100]/2.94 = 13, where 2.94 represents the mean of the outcome variable). The confidence interval for this path/relationship (95 % CI of [0.10, 0.75]) suggests that for every unit increase in a teacher's support for a student, the student's academic performance could increase by 3 % to 26 %.

The second pathway through which teacher support translates into students' end-of-year academic performance is a winding but observable indirect path. The path starts from teacher support to homework student

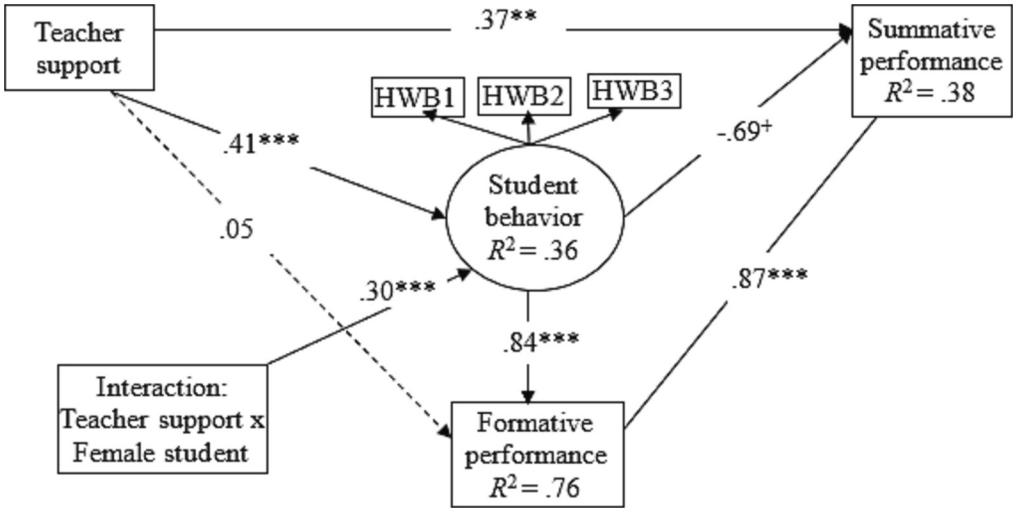

Fig. 2. Results of the moderated chain mediation BSEM.
Note: ***$p < .001$, **$p < .01$, *$p < .05$, $^{+}p < .10$.

behavior ($_{\mu}\beta = 0.41$, PSD = 0.1, $p < .001$, 95 % CI [0.23, 0.59]), then from student behavior to daily (formative) academic performance ($_{\mu}\beta = 0.84$, PSD = 0.09, $p < .001$, 95 % CI [0.66, 1.03]), and from daily performance to end-of-year performance ($_{\mu}\beta = 0.87$, PSD = 0.42, $p < .01$, 95 % CI [0.29, 1.97]). The test for the overall indirect pathway is statistically significant ($_{\mu}\beta = 0.42$, PSD = 0.32, $p < .001$, 95 % CI [0.08, 1.31]). For every unit increase in teacher support, its initial influence on homework behavior and daily academic performance eventually translates into an increase in summative academic performance as low as 0.08 and as high as 1.31 units.

Teacher support also interacts with student gender to positively predict student homework behavior ($_{\mu}\beta = 0.30$, PSD = 0.09, $p < .001$, 95 % CI [0.13, 0.46]), confirming the moderation role of student gender. We found that female students' homework behavior improved by about 0.30 units more than male students for each one-unit increase in teacher support.

5.3.2. Student homework behavior

The factor loadings for the three indicators measuring student homework behavior ranged from 0.47 to 0.83, and were all statistically significant ($p < .001$). We found that teacher support directly shapes student behavior around homework ($_{\mu}\beta = 0.41$, PSD = 0.1, $p < .001$, 95 % CI [0.23, 0.59]), explaining more than a third of the variability in student homework behavior ($R^2 = 0.36$). We also found a direct association between student homework behavior and formative performance or performance on day-to-day academic work ($_{\mu}\beta = 0.84$, $p < .001$, 95 % CI [0.66, 1.02]) but not on summative or end-of-year exam performance ($_{\mu}\beta = -0.69$, $p < .001$, 95 % CI [0.66, 1.02]). Whenever a student's homework behavior increases by one unit, the student's day-to-day behavior improves by 0.66 to 1.02 units.

5.3.3. Formative academic performance

To better understand the role of students' day-to-day academic work in overall performance, we assessed the relationship between performance on formative (i.e., daily) schoolwork and performance on summative exams. We found that performance on formative schoolwork (e.g., homework) was directly and positively associated with performance on the end-of-academic year exam ($_{\mu}\beta = 0.87$, PSD = 0.42, $p < .01$, 95 % CI [0.29, 1.97]). We also assessed the antecedents of students' performance in daily schoolwork. We found that while teacher support was not a direct predictor of students' daily academic performance, it was an indirect predictor of student homework behavior (i.e., teacher support for student behavior, $_{\mu}\beta = 0.41$, PSD = 0.1, $p < .001$, 95 % CI [0.23, 0.59] and student behavior for formative performance, $_{\mu}\beta = 0.84$, PSD = 0.09, $p < .001$, 95 % CI [0.66, 1.03]). The model explained 76 % of the variability in students' daily performance, suggesting the centrality of student homework behavior to daily academic performance.

6. Discussion

The main goal of this study was to assess the influence of teacher support on academic performance and to better understand the mediating role of student homework behavior in the process. To pursue this goal, we delineated student performance during daily schooling (formative assessment) and at the end of their academic program (summative assessment) to better capture the cumulative nature of student learning and performance assessment. The secondary purpose of this study was to examine whether student gender affects the relationship between teacher support and student homework behavior. Before addressing both goals (i.e., establishing structural relationships), we first sought to establish the validity and sufficiency of the student homework construct as a multi-item indicator using Bayesian Confirmatory Factor Analysis.

6.1. Teacher support and student performance in high-stakes testing

The BSEM confirmed that teacher support predicts students' overall academic performance, albeit through multiple pathways. The most direct connection we found was that the support teachers provided to their junior high school students directly translated into a statistically noticeable improvement in their overall academic performance at the end of their educational program. With increased teacher support, a typical student's performance could increase by 13 % (range: 3 % to 26 %), which is sufficient to enable a student to avoid a failing grade. This finding supports our unmediated hypothesis and aligns with several studies showing that teacher support directly affects students' overall GPA (Tennant et al., 2015; Yildirim, 2012) or the performance trajectories of science and technology-related subjects (Ansong et al., 2020).

Evidence of teachers' role in student achievement on high-stakes exams suggests the importance of engendering teacher support to promote student learning outcomes. In Ghana, high-stakes exams are particularly consequential because they affect students' ability to enroll in their preferred senior high school. Students diligently prepare to succeed in these high-stakes exams, and parents invest a lot of money in programs such as supplemental tutoring (Ansong et al., 2023). Teachers, on their part, guide students in their studies, giving exercises and

homework assignments, and grading such assessments (Chiang et al., 2022; Vatterott, 2011). In some cases, teachers work with school administrators to adopt strategies, such as providing camping services for final-year students before the final national examinations to ensure a high pass rate among their students. All these are avenues through which teachers support students in the learning process,

If the current findings about teachers' role in high-stakes exams are evidenced in future large-scale studies from conservatively leaning educational systems, it would provide a stronger case for creating avenues to improve teachers' capacity to effectively support students. Such evidence would lend additional support to the idea that a robust plan to augment teachers' support for students should be a vital component of any comprehensive strategy to improve students' academic success, especially on high-stakes exams. However, it is crucial to note that our findings on the relationship between teacher support and student performance on high-stakes exams do not necessarily mean that students' low performance or failure in high-stakes exams implies a lack of teacher support, as many other factors affect students' academic performance.

Our results highlight how teachers' support for students significantly predicts their high-stakes academic performance, despite the low-income status of the school. This finding from an under-resourced school system suggests that attention to teacher support may translate into improvements in students' academic performance even in resource-limited contexts. Thus, if teacher support enhances student performance, regardless of the low-income context, then it is essential for follow-up studies to investigate how education interventions and policies could enhance conditions that enable teachers to provide a greater level of support to their students.

6.2. Chain mediation effect of homework behavior and low-stakes assessments

Another viable pathway through which teacher support improves students' high-stakes academic performance is the chain mediation effect of student homework behavior and low-stakes academic performance. As expected, the mediating role of student behavior and low-stakes formative exam performance is a major highlight of this study. The first part of the chain mediation—or the empirical connection between teacher support and student homework behavior—fully corroborates previous studies' findings about teacher support's role in student school-related behavior (Alhassan et al., 2017; Feng et al., 2019).

There are several possible reasons why teacher support predicts student achievement. For instance, by assigning meaningful homework that engages students outside regular school hours, teachers are able to stimulate and cultivate learning habits among students beyond the confines of the school. As Alhassan and colleagues (2017) found, teacher support is strongly linked to increased student study hours. The grading of homework assignments may create opportunities for teachers to monitor and offer meaningful feedback to students, incrementally helping to improve students' academic work. Teachers' failure to follow through with such engagements may diminish students' dedication to their schoolwork. However, when teachers support students' cultivation of positive behaviors, they foster improved academic achievement (Suárez et al., 2019). Knowing that an optimal way to improve student performance on low-stakes formative exams is through teachers' support for homework activities is a crucial insight that can help teachers calibrate their level and the nature of engagement with students to improve their performance.

Our findings also reveal that the second part of the chain mediation from teacher support to high-stakes exam performance is the intervening role of low-stakes exam performance. In other words, if teachers help their students cultivate and exhibit good homework behaviors through their support, such behavior may positively affect their day-to-day schoolwork (or their performance on low-stakes formative assessments). On the other hand, students with disruptive homework behaviors may miss out on daily schoolwork and consequently struggle to succeed in low-stakes tests, not to mention high-stakes exams.

The use of low-stakes formative assessments to evaluate students' performance is partly grounded in the idea that low-stakes interim assessments give teachers, students, and sometimes parents the opportunity to monitor the progress of students throughout the term and provide relevant feedback necessary for improvement in the final examinations (Carrillo-de-la-Peña & Perez, 2012; Samson & Marongwe, 2013). Such ongoing input from low-stakes academic work may encourage students to study more to boost their performance in the weakest subject areas. This study's differentiation between low-stakes schoolwork (e.g., formative assessments) and high-stakes exams (e.g., summative assessments) is crucial, because each type of assessment targets different aspects of student learning. Unlike high-stakes exams, which measure students' overall performance over an academic period, low-stakes exams create opportunities for ongoing mechanisms for both students and teachers to assess performance and institute remedial measures when necessary. Thus, differentiating between these two student performance measures could inform the creation of tailored interventions to fill specific learning needs and performance gaps during different periods of the academic year.

6.3. The moderating role of student gender

The results showed that teachers provided slightly more support to boys than girls, although the difference was not statistically significant. Our findings also reveal that student gender is a moderator, with every unit increase in teacher support contributing to a 0.30-unit improvement in female students' homework behavior compared to male students. In other words, while increased student support from teachers benefits students of all genders, it may have a greater effect on female students. This finding aligns with findings of earlier studies that identified gender differences in both school-related behavior (Alhassan et al., 2017) and academic performance (Iqbal & Anjum, 2017), primarily due to overt and subtle socialization practices discussed earlier (Eschenbeck et al., 2007; Kitsantas & Zimmerman, 2009).

Our findings related to gender differentiation suggest that a comprehensive analysis of the impact of teacher support on students' everyday academic work and later academic performance should consider student gender as a moderating factor. Likewise, interventions aimed at shoring up teacher support in schools could benefit from tailoring aspects of the interventions or delivery mechanisms to the unique needs of the various genders.

7. Conclusion

7.1. Limitations and strengths

The promising findings of this study should be considered considering its limitations. One advantage of the Bayesian framework over frequentists is its ability to incorporate prior data into new primary data. However, in this study, we relied on non-informative priors for a few structural pathways because of limited published data on these pathways. In addition, one nuanced result picked up in our analysis is the possible disconnect between homework behavior and high-stakes summative exam performance. Current data do not shed light on this phenomenon because of the limited availability of temporal data. Future research should investigate how ongoing home behavior may impact students' long-term academic success. Another drawback of this study is the lack of data on teacher characteristics, which increases the likelihood of omitted variable bias. Future studies should capture relevant data on teacher characteristics to provide additional nuanced insights into the impact of teacher support.

The teacher support scale, although parsimonious, may be inexhaustive. It has limited internal consistency, potentially reducing the scale's sensitivity. We conducted sensitivity tests by replacing the teacher support scale with the individual observed items and found

slight differences in the magnitude of the coefficients but no observable difference in the direction of the coefficients or the significance level. Similarly, the choice of Bayesian framework is relevant for improving the precision of the estimates, given the study's small sample size. Notwithstanding these statistical fixes to the potential measurement and statistical power limitations, we urge a more conservative interpretation of the study results. Until further studies replicate and validate these findings, we encourage readers to exercise caution by not solely relying on the current findings for consequential decision-making.

Notwithstanding these limitations, the current study contributes to the extant literature on teacher support by providing robust evidence from low-resource and conservatively leaning contexts that bolster support for prior findings and broaden their relevance to varying geographical contexts. Our Bayesian approach of combining existing knowledge with new data increases the robustness of current evidence concerning teachers' direct role in students' success in high-stakes endeavors. Unlike prior teacher support studies, we specifically employ Bayes' theorem by incorporating a prior probability distribution with new sample information from a resource-constrained country. We also pursue replication checks through the conventional maximum likelihood, thus increasing the confidence we have thus far about teacher support's unmediated, mediated, and moderated-mediated roles in student performance, particularly in summative and high-stakes exams. Stronger evidence of teacher support's ability to promote positive academic outcomes for students is essential for enhancing programming and interventions designed to improve students' academic success. Thus, the advanced modeling approach to understanding teachers' role in the matrices that count toward students' academic progress makes a timely and vital contribution to the quality of relevant evidence.

7.2. Contributions to narrowing the empirical gaps

Education undoubtedly presents opportunities for individual growth, character building, and overall personal development, not to mention direct and indirect contributions to national development (Herrera et al., 2018; Yuliani & Hartanto, 2017). Undeniably, teachers play a crucial role in supporting students' academic success and growth and preparing them for their career trajectory and contribution to society. However, empirical research has not sufficiently examined how teacher support results in higher performance in under-resourced school environments. Thus, the current study's evidence of the mediating role of student performance in daily schoolwork further underscores the centrality of low-stakes formative work to students' overall academic performance. This finding from a resource-limited context contributes to the evidence base that shows how teacher support matters for student learning outcomes in the short and long term. To further advance our understanding of how students' everyday academic performance impacts their performance on summative assessments, future studies must trace the mechanism linking the various dimensions of teacher support to everyday academic performance to summative performance. Understanding this chain mediation process is particularly important for interventionists and administrators seeking to implement empirically informed interventions.

To date, the literature on teacher support and its influence on children's academic performance typically assesses performance via summative outcomes (or performance at the end of an academic term or program), which are often tracked through high-stakes national standardized exams. In comparison, the linking role of students' day-to-day academic performance, which is crucial for enabling students to progress in academic programs, remains underexplored. Performance on such day-to-day formative assessments is not only a precursor of performance on final or summative exams; it can also often enable teachers and schools to identify in advance children who may struggle with the summative exam, allowing remedial measures to be implemented sooner rather than later. Encouragingly, with a particular focus on formative assessment, the current study has highlighted that more teacher support and investment in students' day-to-day academic work may boost their learning success both in the short and long term.

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CRediT authorship contribution statement

David Ansong: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Moses Okumu:** Conceptualization, Methodology, Writing – original draft. **Emmanuel Owusu Amoako:** Project administration, Writing – original draft, Writing – review & editing. **Jamal Appiah-Kubi:** Writing – original draft, Writing – review & editing. **Abena Oforiwaa Ampomah:** Investigation, Writing – original draft, Writing – review & editing. **Isaac Koomson:** Data curation, Methodology. **Eric Hamilton:** Writing – review & editing.

Declaration of competing interest

None.

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