



Digital Inequality Beyond Access: Family Resources, Learning Agency and Social Development in Hybrid Education

Mohammad Farid Budiono

Department of Social Development and Welfare, Faculty of Social and Political Sciences, Universitas Gadjah Mada, Yogyakarta, Indonesia

Abstract

Digital inequality in hybrid education extends beyond device ownership and internet access to include differences in family resources, learning agency, and opportunities for social participation. This study examined relationships among these factors using a quantitative, cross-sectional secondary-data design. A cleaned and stratified sample of 500 student records was extracted from the "Student Performance Factors: Insights into Student Performance and Contributing Factors" dataset. Composite proxy indices were constructed for digital inequality, family resources, learning agency, and social participation. Descriptive statistics, group comparisons, correlation analysis, hierarchical regression, and bootstrapped mediation analysis were conducted. Digital inequality was negatively associated with examination performance but showed no significant relationship with learning agency or social participation. Family resources significantly predicted examination performance, whereas learning agency emerged as the strongest positive predictor. Social participation also made a small positive contribution to academic achievement. However, learning agency did not significantly predict social participation and did not mediate the relationships of digital inequality or family resources with social participation. Findings indicate that access alone is insufficient to explain educational inequality. Academic success in hybrid learning contexts depends on material resources, family support, motivation, study effort, attendance, and opportunities for social engagement. Institutions should therefore combine digital provision with targeted support for self-regulation, parental involvement, and inclusive participation.

Keywords: digital inequality; family resources; learning agency; social development; hybrid education; academic performance

1. Introduction

Hybrid Education involves a blend of in-person learning and online materials, platforms and interactions. This model is flexible and can increase participation, but it can also highlight inequalities which are not solely due to internet access or device ownership. Digital inequality is the result of disparities in social status, resources, skills and the capacity to translate the use of the Internet into positive outcomes, Helsper (2021) states. Similarly, Lythreath et al. (2022) define the digital divide as multi-faceted and consisting of unequal access, competence, use and consequence. This view is particularly pertinent to hybrid learning, where accessing the education quality that enables students to participate in effective learning without compromising their health and wellbeing requires connectivity, appropriate devices, digital literacy, family support, and competence in managing learning both physically and virtually.

Having the technology does not guarantee equality in learning opportunity. Lai and Widmar (2021) noted how the COVID-19 situation brought back the focus on the connectivity and technology usage among persistent gaps. In Nigeria, disadvantaged learners were not able to participate in remote learning due to inequitable access to devices, electricity and online platforms (Azubuike et al., 2021). Cullinan et al., (2021) noted that there were similar disparities between higher education students who did not have reliable broadband and suitable conditions for study. Golden et al. (2023) also stated that remote learning exacerbated current inequities in the education system by amplifying the effects of these factors. Digital inequality in hybrid education should therefore not be interpreted as a dichotomy between “connected” and “unconnected” students, but rather as a difference in how technology can be used to benefit students.

This unequal capacity is at the heart of the family resources. Students are from homes of varying incomes, parents' education, study space, learning materials, expectations and support. González-Betancor et al. (2021) demonstrated that schools can mitigate some types of digital disadvantage at home, but do not necessarily eradicate it. Affordability, infrastructure, digital skills, and family support are also factors that influence online learning outcomes in developing contexts (Mathrani et al., 2022). Bacher-Hicks et al. (2021) found that the level of disruption at school influenced how households engaged with the online learning space, with more advantaged households being more successful at sustaining engagement. For hybrid education, family resources can therefore impact access and quality of student participation.

These inequalities are also influenced by learning agency, which refers to students' capacity to direct effort, maintain motivation, manage their own study time, seek assistance and actively respond to learning opportunities. In hybrid environments, independence is a little more critical since students have to work on more than one platform and online activities, and supervision is limited. Motivation, attendance, study behaviour and confidence could be key factors in whether the resources are translated into positive outcomes. Baker and Spenceley (2023) reported that hybrid teaching does not necessarily result in equivalent learning experiences and Bond et al. (2021) found that there were differences in engagement, communication, and institutional readiness with emergency remote teaching. These results suggest that agency needs to be considered in conjunction with technological and family conditions.

Another key but under-researched aspect of hybrid learning is social development. Education is not just about academic achievement, it is also about peer connections, communications, belonging, and working together. Students who have limited access to digital devices and/or weak learning agency may be less likely to engage in online discussions, group activities, extracurricular activities, and peer networks. The digital-education ecosystems should thus be a mix of infrastructure and accessible pedagogy, teacher capacity, learner support, and inclusive interaction (Bo, 2025). Furthermore, digital-device use is not always linked to positive academic outcomes, as the impact of digital devices on educational outcomes is influenced by the quality, purpose, and context of their use (Wang et al., 2024). There should thus be a comprehensive analysis that links digital inequality, family resources, learning agency, social participation and performance.

While there has been a growing body of research around online learning, many of the studies still focus on either access to the digital media, family factors, student engagement or achievement. There is little empirical research that integrates these dimensions in a framework that transcends access and explores how family resources and learning agency are related to social development in hybrid education. The study aims to overcome this gap by: examining digital inequality of students; assessing the relationship between family resources and learning agency; determining whether digital inequality and family resources predict social development; evaluating the association of learning agency with social participation and examination performance; and testing whether learning agency mediates the relationships of digital inequality and family resources with social development.

2. Materials and Methods

2.1 Research Design

The research adopted a quantitative research design, cross-sectional, and explanatory in order to look at the relationship between digital inequality, family resources, learning agency and social development in the context of digitally supported and hybrid educational environments. Secondary student level data were used

and statistical modelling determined the association between variation in internet access and educational resources, and students' capacity to engage actively in learning and participate socially. Explanatory design was suitable for the study as it aimed to explore the direct and indirect links between the key constructs and not just describe the characteristics of the students. Family resources and digital inequality were considered as explanatory variables, learning agency was analyzed as a mediating variable and social participation was assumed as an empirical proxy for social development. As an additional education outcome, academic performance was added. Hybrid education was considered as a more general concept of the education context in which online and face-to-face teaching is relevant, as the source dataset did not provide a direct variable to identify the proportion of online and face-to-face instruction.

2.2 Secondary Data Source

The study used the publicly available secondary dataset titled “Student Performance Factors: Insights into Student Performance and Contributing Factors,” obtained from the Kaggle data repository (Ng, 2025). The original dataset contained 6,607 student observations and 20 variables relating to academic performance, family background, educational resources, internet access, motivation, attendance, study behaviour, peer influence, extracurricular participation, and school characteristics. The unit of analysis was the individual student.

The dataset was selected because it contained several variables relevant to the conceptual dimensions of the study. Internet access and access to educational resources represented basic forms of digital inequality; family income, parental education, parental involvement, and tutoring represented family resources; motivation, hours studied, and attendance reflected learning agency; and peer influence, extracurricular participation, and physical activity provided indicators of social participation. Previous scores and examination scores were retained as educational-performance measures.

2.3 Dataset Extraction and Sample Selection

A new secondary analytical data set was created from the original data set, with the aim of creating a smaller and cleaner data set for focused statistical analysis. A total of 500 student observations and 23 variables were extracted and provided for analysis. Stratification was done by internet-access status to ensure adequate representation of students who were digitally disadvantaged. Extracted sample consisted of 400 students who have internet and 100 who do not have internet. This distribution had the effect of enhancing the analytical comparison between digitally connected and digitally disadvantaged students because, in the original data set, students who did not have access to the internet were a comparatively small group.

All observations lacking any information for one or more of the variables of interest were excluded. No missing data or duplicate data were found in the extracted dataset. Examination scores were verified to make sure that all the scores that were retained were in the valid range of 0-100. Every observation was given an anonymous student ID code, and each source row number was kept only for data traceability. Because students who did not have access to the internet were over-sampled, the prevalence of these characteristics in the extracted sample were interpreted as characteristics of the analytical sample, not as prevalence estimates for the total original sample.

2.4 Study Variables and Operationalisation

Digital inequality was operationalised through Internet_Access and Access_to_Resources. Internet access was coded according to whether a student had access to the internet, while educational resources were classified as low, medium, or high. A composite variable titled Digital_Inequality_Proxy_0_4 was constructed. Internet access was coded 0 for “Yes” and 2 for “No,” whereas access to resources was coded 0 for high, 1 for medium, and 2 for low. The two scores were added to produce a digital-inequality score ranging from 0 to 4, with higher values indicating greater digital and resource disadvantage.

Family resources were represented by family income, parental involvement, parental education, and tutoring sessions. Family income and parental involvement were coded from 0 for low to 2 for high. Parental education was coded 0 for high school, 1 for college, and 2 for postgraduate education. Tutoring sessions were scored from 0 to 3, with values above three capped at three to prevent unusually high tutoring frequency from dominating the index. These measures were combined into the Family_Resources_Proxy_0_9, with higher scores indicating stronger economic, educational, and parental support.

Learning agency was measured through motivation level, weekly study hours, and attendance. Motivation was coded as 0 for low, 50 for medium, and 100 for high. Hours studied were converted to a percentage using a reference maximum of 40 hours per week. Attendance was normalised between 60% and 100%, with higher attendance representing stronger educational engagement. The average of the three standardised components produced the Learning_Agency_Proxy_0_100. Higher scores represented stronger motivation, sustained study effort, and active participation in formal learning.

Social development was approximated through a social-participation index because the secondary dataset did not contain a validated multidimensional social-development scale. Peer influence was coded as 0 for

negative, 50 for neutral, and 100 for positive. Extracurricular participation was coded 0 for “No” and 100 for “Yes,” while physical activity was converted to a percentage based on a maximum value of six. The average of these components formed the *Social_Participation_Proxy_0_100*, with higher values indicating more positive peer environments and stronger participation in social and extracurricular activities.

Gender, school type, and distance from home were included as control variables. Previous academic scores were used to control for earlier educational achievement, while examination score was treated as a supplementary outcome indicating current academic performance.

2.5 Data Cleaning and Preparation

The data collected were systematically screened prior to analysis. The conceptually relevant variables were kept and renamed consistently and the variables not relevant to the objectives of the study were excluded. The extracted dataset was complete and no repeated observations were found by performing missing-value analysis and duplicate detection. Thus no statistical imputation was needed. Categorical variables were coded as numeric variables if needed and continuous variables were checked for minimum values, maximum values, means, standard deviations and outliers. Transparent scoring procedures were used to create composite scores, with higher scores always representing higher levels of inequality, family resources, learning agency, or social participation, depending on the construct.

2.6 Statistical Analysis

Descriptive Statistics were used to describe the characteristics of the sample. For categorical variables, frequencies and percentages were calculated and for continuous and composite measures, means, standard deviations, minimum and maximum were reported. Independent-samples t-tests were conducted to compare the students with Internet and without Internet. A one-way analysis of variance was used to compare the various categories of family-income, parental-involvement, and resource-access on learning agency, social participation, and examination performance.

To explore the association between digital inequality, family resources, learning agency, social participation and academic performance, Pearson or Spearman correlation analysis was used, depending on the distribution of the variables. Then, hierarchical multiple regression analysis was performed. Demographic and educational control variables were included in the first model, digital inequality and family resources were included in the second model, and learning agency was added to the final model. The primary dependent variable was social participation, with examination performance being a secondary dependent variable.

A mediation analysis was conducted to test whether learning agency mediated the relationship between family resources and social participation. The association between digital inequality and social participation was examined in an additional model, in which learning agency was considered as a mediator. 5,000 bootstrap samples and 95% confidence intervals were used to assess indirect effects. Variance inflation factors were used to test for multicollinearity and before interpreting the results of the regression analysis, the normality, linearity, independence and heteroscedasticity of the residuals were examined. Statistical significance was established at $p < 0.05$.

2.7 Ethical Considerations

The research involved the secondary analysis of a publicly available, anonymised dataset. No direct interaction with students occurred, and the extracted file contained no names, addresses, contact information, or other personally identifiable information. The data were used exclusively for academic purposes and handled according to the terms of the public repository. The study therefore presented minimal ethical risk. Nevertheless, institutional requirements concerning ethical exemption or approval for secondary-data research should be followed before publication.

3. Results

The analysis was performed on the secondary data set of 500 complete student observations that was extracted and cleaned. The analytical data set did not contain any missing values or duplicate records. Digital inequality, family resources, learning agency and social participation were assessed using the proxy indices outlined in the methodology. Due to the lack of a validated social-development scale in the original secondary data set, social development was used as an empirical indicator, namely, the *Social_Participation_Proxy_0_100*.

3.1 Characteristics of the Analytical Sample

There were 400 students with Internet access and 100 students without Internet access. Almost half of the students indicated medium access on educational resources and 21.6% had low access on educational resources as presented in Table 1. The combined proportion of low- and medium-income families was 80.4% of the sample. Around half of the students were in the medium level of motivation and 56.6% engaged in extra-curricular activities.

Table 1. Demographic, family and educational characteristics of the sample

Variable	Distribution, n (%)
Internet access	Yes: 400 (80.0%); No: 100 (20.0%)
Access to resources	Low: 108 (21.6%); Medium: 248 (49.6%); High: 144 (28.8%)
Family income	Low: 203 (40.6%); Medium: 199 (39.8%); High: 98 (19.6%)
Parental involvement	Low: 110 (22.0%); Medium: 273 (54.6%); High: 117 (23.4%)
Parental education	High school: 255 (51.0%); College: 150 (30.0%); Postgraduate: 95 (19.0%)
Motivation level	Low: 153 (30.6%); Medium: 250 (50.0%); High: 97 (19.4%)
Peer influence	Negative: 109 (21.8%); Neutral: 202 (40.4%); Positive: 189 (37.8%)
Extracurricular activities	No: 217 (43.4%); Yes: 283 (56.6%)
School type	Public: 358 (71.6%); Private: 142 (28.4%)
Distance from home	Near: 294 (58.8%); Moderate: 157 (31.4%); Far: 49 (9.8%)
Gender	Female: 215 (43.0%); Male: 285 (57.0%)

3.2 Descriptive Statistics of the Principal Variables

The mean digital-inequality score was 1.33 on the 0–4 scale, representing a relatively low level of digital and resource inequality for an average student. But the full spectrum of 0-4 was filled. The average score on the family-resources item was 3.98 on 9. The mean score for learning-agency was 48.84 and for social-participation was 54.54 (Table 2).

Table 2. Descriptive statistics of the principal study variables

Variable	N	Mean	SD	Minimum	Maximum
Digital inequality	500	1.33	1.03	0.00	4.00
Family resources	500	3.98	1.75	0.00	9.00
Learning agency	500	48.84	15.32	8.33	90.00
Social participation	500	54.54	21.70	0.00	94.44
Previous academic score	500	74.51	14.80	50.00	100.00
Examination score	500	67.02	3.50	58.00	93.00

The distribution of the digital-inequality index is shown in Figure 1. The most frequent score was 1 (198 students) followed by 2 (124 students). Just 17 students scored a digital-inequality score of 4 (full scale).

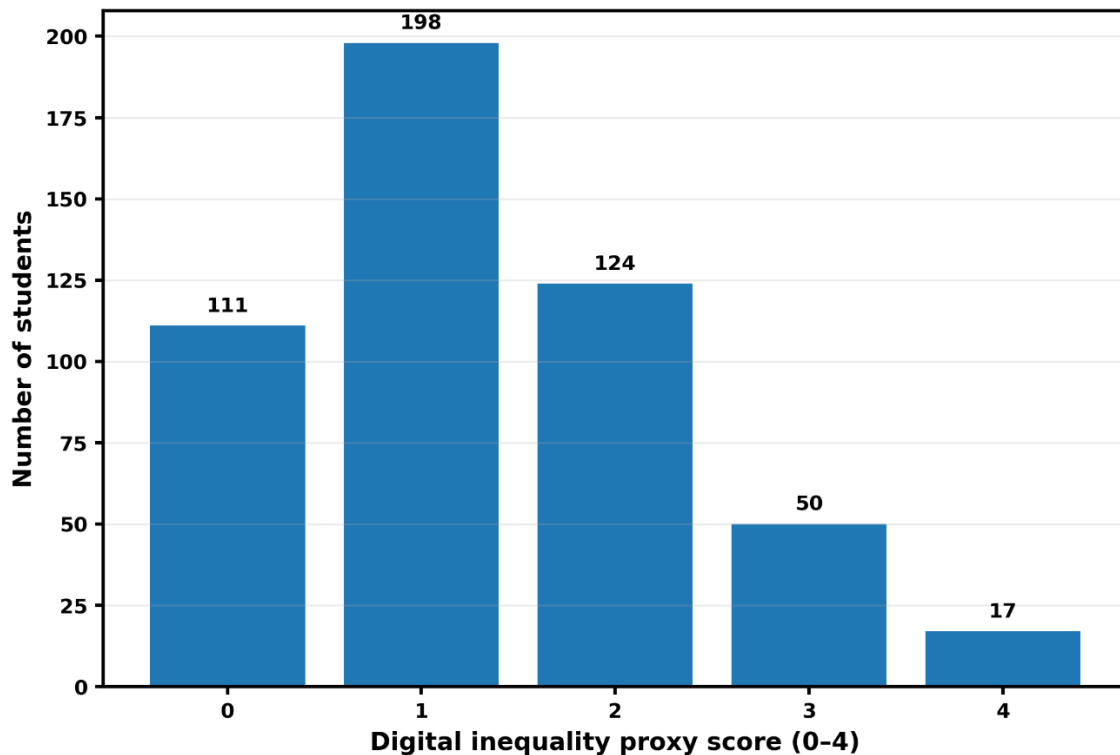


Figure 1. Distribution of Digital Inequality Scores Among Students

3.3 Relationships Among Digital Inequality, Family Resources, Learning Agency and Social Participation

Pearson correlation analysis showed that digital inequality was not significantly associated with family resources, learning agency or social participation. However, digital inequality had a significant negative relationship with examination performance, $r = -.139$, $p = .002$. Students experiencing greater combined internet and educational-resource disadvantage therefore tended to achieve lower examination scores.

Family resources were significantly and positively associated with examination performance, $r = .280$, $p < .001$, but were not associated with either learning agency or social participation. Learning agency demonstrated the strongest correlation with examination performance, $r = .561$, $p < .001$. Social participation was also positively, although weakly, associated with examination performance, $r = .107$, $p = .017$. The complete correlation matrix is presented in Table 3.

Table 3. Pearson correlations among the principal variables

Variable	1	2	3	4	5	6
1. Digital inequality	1.000					
2. Family resources	.015	1.000				
3. Learning agency	.044	-.013	1.000			
4. Social participation	-.018	-.058	.020	1.000		
5. Previous scores	-.033	.038	.045	-.096*	1.000	
6. Examination score	-.139**	.280***	.561***	.107*	.292***	1.000

Note. $p < .05$; $p < .01$; $p < .001$.

The graph pattern of Figure 2 also indicates that the linear relationship between family resources and learning agency is very low. Likewise, there is almost a horizontal trend between learning agency and social participation as shown in Figure 3. These results suggested that the data did not allow for the proposed direct relationships between family resources, agency and the social-participation proxy.

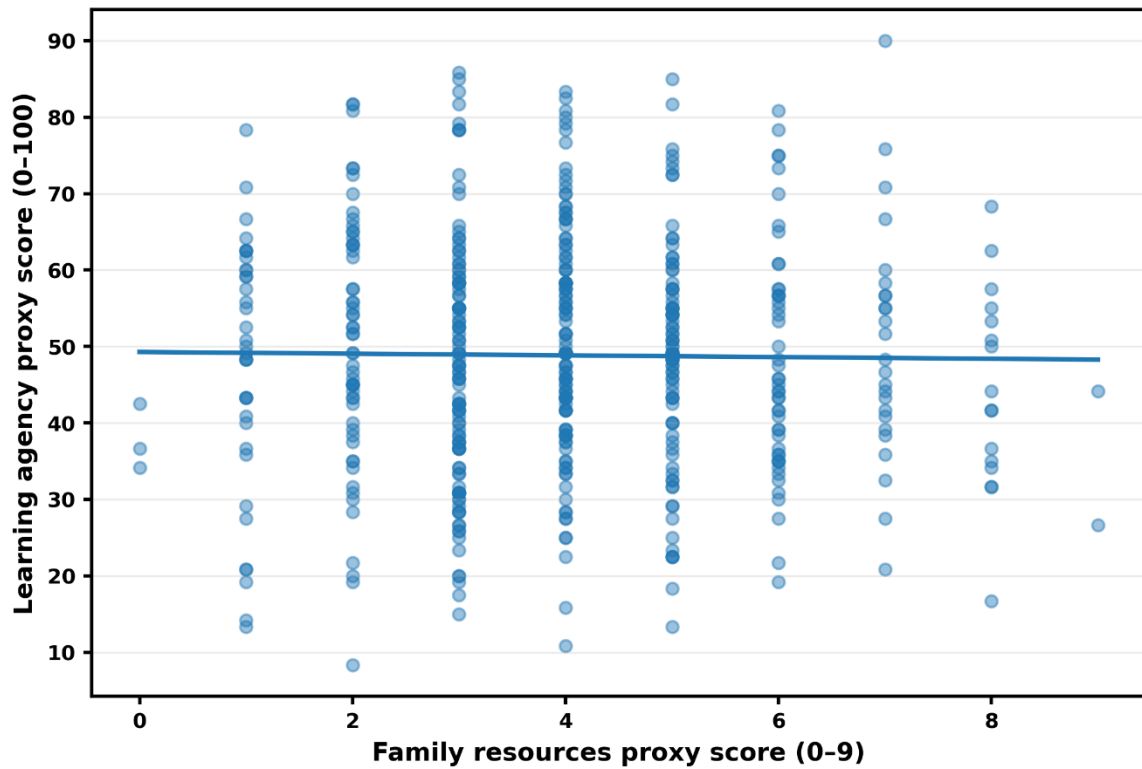


Figure 2. Relationship Between Family Resources and Learning Agency



Figure 3. Relationship Between Learning Agency and Social Participation

3.4 Differences According to Internet Access

Welch's independent-samples t-tests were conducted to compare students with and without internet access. Students without internet access had a substantially higher mean digital-inequality score than students with internet access, $t(155.22) = -24.30$, $p < .001$, Hedges' $g = -2.67$. This result was expected because internet access was one component used in constructing the digital-inequality index.

There were no significant differences between those with and without internet access in terms of family

resources, learning agency, social participation or examination scores. Social-participation scores were nearly the same for students with internet access and those without access, as shown in Table 4 in particular.

Table 4. Comparison of students with and without internet access

Outcome	Internet access: Yes, Mean $\pm$ SD	Internet access: No, Mean $\pm$ SD	Welch's t	p	Hedge's g
Digital inequality	0.95 $\pm$ 0.71	2.84 $\pm$ 0.69	-24.30	<.001	-2.67
Family resources	3.98 $\pm$ 1.72	4.00 $\pm$ 1.85	-0.11	.912	-0.01
Learning agency	48.52 $\pm$ 14.93	50.11 $\pm$ 16.81	-0.86	.389	-0.10
Social participation	54.43 $\pm$ 22.02	55.00 $\pm$ 20.51	-0.24	.807	-0.03
Examination score	67.02 $\pm$ 3.32	67.02 $\pm$ 4.18	-0.01	.991	-0.00

Figure 4 shows the average social-participation score for each of the five digital-inequality levels. There was no systematic decrease in social participation as digital inequality increased the social participation score was in the 52–56 point range in all categories, and the 95% confidence intervals overlapped.

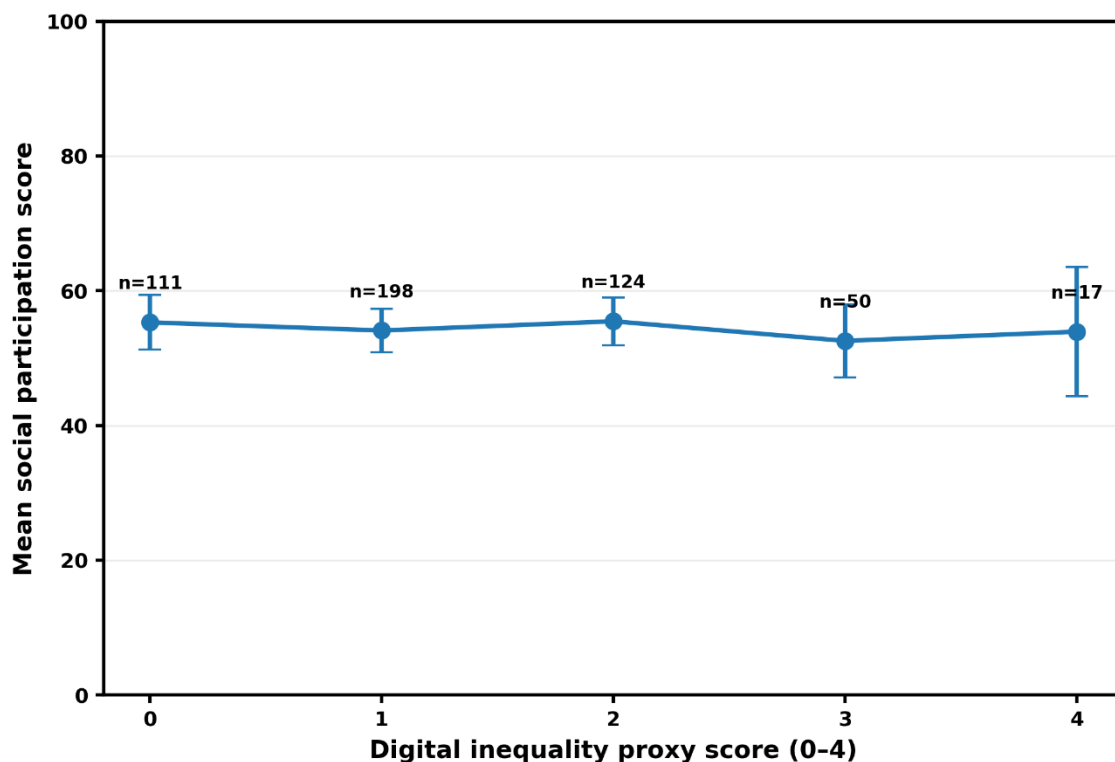


Figure 4. Mean Social Participation Across Levels of Digital Inequality

A supplementary one-way analysis of variance also found no significant differences in learning agency across low-, medium- and high-income families, $F(2, 497) = 0.55$, $p = .575$, $\eta^2 = .002$. Social participation similarly did not differ across family-income categories, $F(2, 497) = 0.70$, $p = .498$, $\eta^2 = .003$. A small difference was observed for examination scores, $F(2, 497) = 3.03$, $p = .049$, $\eta^2 = .012$, with students from high-income families reporting the highest average score.

3.5 Predictors of Social Participation

Hierarchical regression analysis was used to determine whether digital inequality, family resources and learning agency explained variation in social participation. Gender, school type, distance from home and previous academic scores were entered as controls in Model 1. Digital inequality and family resources were added in Model 2, followed by learning agency in Model 3.

As reported in Table 5, Model 1 explained only 1.9% of the variance in social participation and was not statistically significant. The introduction of digital inequality and family resources increased the explained

variance by only 0.3%. Learning agency contributed an additional 0.1%. The final model explained 2.3% of the variance and was not statistically significant, $F = 1.31$, $p = .234$.

Digital inequality, family resources and learning agency were not significant predictors of social participation. Previous academic achievement was the only significant predictor, but the relationship was small and negative, $\beta = -.095$, $p = .040$.

Table 5. Hierarchical regression predicting social participation

Predictor	Model 1 β	Model 2 β	Model 3 β
Male gender	.062	.063	.062
Private school	-.042	-.041	-.039
Moderate distance from home	-.013	-.013	-.015
Far distance from home	-.070	-.070	-.073
Previous academic score	-.095*	-.094*	-.095*
Digital inequality	—	-.023	-.024
Family resources	—	-.053	-.052
Learning agency	—	—	.030
R^2	.019	.023	.023
Adjusted R^2	.009	.009	.008
Change in R^2	—	.003	.001
Model p value	.121	.183	.234

Note. Standardised coefficients are reported. Robust HC3 standard errors were used. $p < .05$.

3.6 Predictors of Examination Performance

Although the proposed social-development pathway was not supported, the variables demonstrated considerably stronger explanatory value for academic performance. The examination-performance model was statistically significant, $F = 98.75$, $p < .001$, and explained 51.2% of the variance in examination scores.

Learning agency was the strongest predictor of examination performance, $\beta = .564$, $p < .001$. Family resources also had a significant positive effect, $\beta = .289$, $p < .001$, while previous academic achievement had a positive effect, $\beta = .267$, $p < .001$. Digital inequality remained a significant negative predictor after controlling for the remaining variables, $\beta = -.158$, $p < .001$. Social participation was positively associated with examination performance, $\beta = .133$, $p < .001$.

Students living a moderate distance from school reported slightly lower examination performance than those living near school, $\beta = -.071$, $p = .022$. Gender, school type and living far from school were not significant predictors. These results are reported in Table 6 and graphically presented in Figure 5.

Table 6. Multiple regression predicting examination performance

Predictor	Standardised β	Robust SE	t	p	95% CI
Male gender	-.029	.033	-0.88	.381	[-.093, .035]
Private school	.008	.030	0.25	.805	[-.052, .067]
Moderate distance	-.071	.031	-2.29	.022	[-.131, -.010]
Far distance	-.044	.033	-1.34	.181	[-.109, .021]
Previous academic score	.267	.036	7.52	<.001	[.197, .337]
Digital inequality	-.158	.031	-5.10	<.001	[-.219, -.097]
Family resources	.289	.028	10.14	<.001	[.233, .345]
Learning agency	.564	.031	18.28	<.001	[.504, .624]
Social participation	.133	.037	3.62	<.001	[.061, .205]

Note. $R^2 = .512$; adjusted $R^2 = .504$; $N = 500$.

As illustrated in Figure 5, learning agency produced the largest positive standardised coefficient. Family resources and previous scores also made substantial positive contributions, whereas digital inequality negatively predicted academic performance.

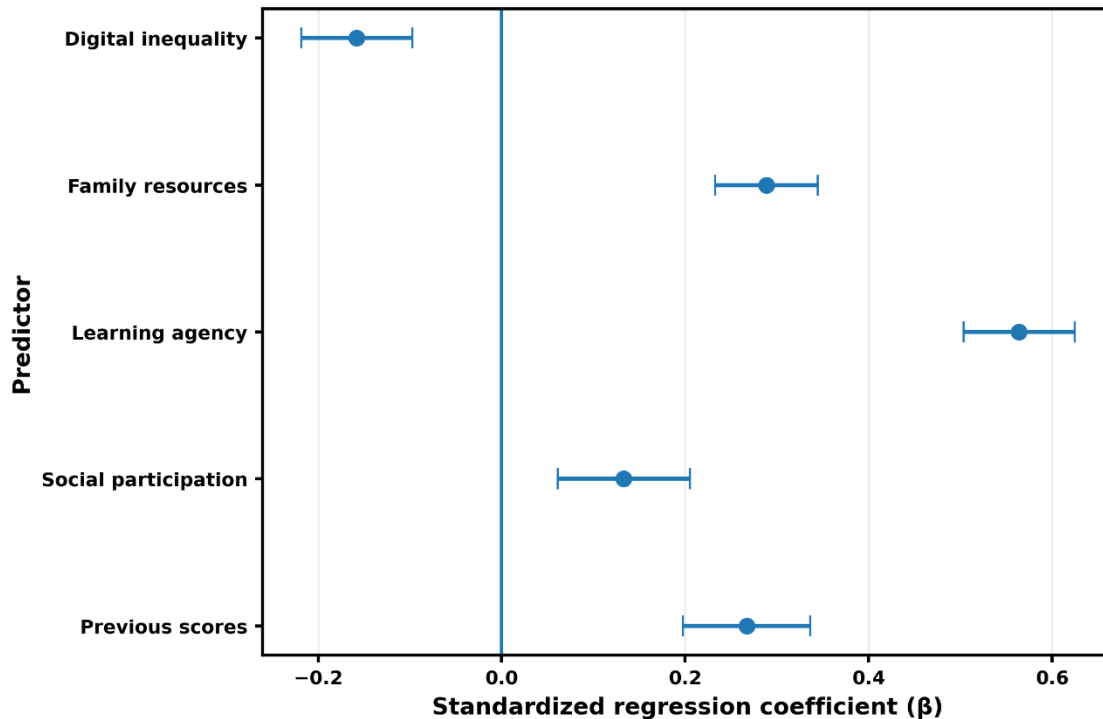


Figure 5. Standardised Predictors of Students' Examination Performance

3.7 Mediation Analysis

Bootstrapped mediation analysis was conducted using 5,000 resamples. Learning agency did not mediate the relationship between family resources and social participation because the indirect effect was -0.006 and its 95% bootstrap confidence interval included zero. Learning agency also did not mediate the relationship between digital inequality and social participation. The indirect effect was 0.034 , with a confidence interval ranging from -0.097 to 0.208 , as presented in Table 7.

Table 7. Bootstrapped indirect effects through learning agency

Mediation pathway	Indirect effect	Bootstrap 95% CI	Result
Family resources → Learning agency → Social participation	-0.006	$[-0.084, 0.047]$	Not significant
Digital inequality → Learning agency → Social participation	0.034	$[-0.097, 0.208]$	Not significant

The mediation findings indicate that learning agency did not explain how family resources or digital inequality were related to the social-participation proxy. Nevertheless, the strong academic-performance model demonstrated that digital inequality, family resources, learning agency and social participation were independently relevant to educational achievement.

4. Discussion

The results give a nuanced picture of the functioning of digital inequality, family resources, learning agency and social participation in hybrid school contexts. Digital inequality was not significantly linked to family resources, learning agency and social participation, but negatively linked to examination performance. This indicates that disparities in Internet and educational-resource access do not necessarily diminish students' motivation or engagement, but they can still limit academic performance. Students can continue to learn despite their disadvantage, but access to learning is often intermittent, and resources are limited which can be a disadvantage.

The family resources were positively related to examination performance, but not to learning agency or social participation. This reinforces the idea that parents' education, income, involvement, and tutoring can be used as a means to enhance achievement through material support, guidance, and structured learning environment. Alharthi (2023) identified that parents played crucial supervisory and technological roles during online education, and Li et al. (2023) demonstrated a connection between parental academic support and expectations

and better achievement. Likewise, Xiong et al. (2021) discovered that parental involvement can help to achieve academic engagement. The results, however, show that the relationship between household advantage and learning agency is not significant, suggesting that it might not be a direct relationship. Núñez et al. (2023) stated that parental involvement can be a complex motivational process and Yang et al. (2023) came to the conclusion that the impact depends on the type and quality of parental involvement.

Learning agency proved to be the best predictor of examination performance. This was the case even when digital inequality, family resources, prior attainment and social engagement were accounted for, as students with higher levels of motivation, study effort and attendance had higher scores. This result is in line with Chiu (2022) who showed that autonomy, competence, and relatedness are conducive to online engagement. This also resonates with Lobos et al. (2024) who highlighted self-regulated learning as one of the key conditions needed in blended settings. Hybrid learning increases the burden on students to schedule time, focus their attention and to transition between learning environments (in person and online). Access is educationally productive if it is accompanied by students having the agency to make purposeful use of the opportunities they have.

Contrary to expectations, learning agency did not significantly predict social participation nor did it mediate the relationships of digital inequality or family resources with social participation. One explanation is that agency is not just an individual attribute, but is contingent upon relationships and opportunities in context. Mairitsch et al. (2023) maintained that learner agency is socially located and is a result of interactional affordances. The current proxy included peer influence, extracurricular involvement, and physical activity; however, did not directly assess communication, belonging, collaboration, or social confidence. Thus, the lack of significance may be due to the limits of measurement rather than lack of relationship between the variables of agency and social development.

There was no relationship between family resources and social participation, although there was past literature that related family involvement to social-emotional outcomes. School engagement can be used as a mediator for the effect of family involvement on social-emotional development, as found by Martinez-Yarza et al., (2024). The present result may vary as it was based on the data of parental and economic resources, and not of emotional communication, family climate, peer support and school belonging. Furthermore, students from various resource backgrounds may report similar involvement in extracurricular activities despite the quality of their extracurricular experiences. This points to the need of separating visible participation from more social-development outcomes.

Examination performance had a small positive impact on social participation, suggesting that there may be a small contribution of supportive peer environments and extracurricular engagement to achievement. Miao & Ma (2022) demonstrated that online interaction and social presence enhance engagement and self-regulation. Wagner et al. (2025) also showed that learning activities and social presence in synchronous hybrid classrooms drive experiences. Wheele et al. (2024) also demonstrated that obtaining social interaction opportunities in a hybrid university requires opportunities for meaningful interaction beyond the screen. These findings contribute to understanding how social participation can positively impact performance even if it is not necessarily strongly influenced by digital inequality and learning agency.

Results have implications for blended learning. Beyond device provision, institutions need to incorporate reliable connectivity with academic mentoring, self-regulated learning support, inclusive peer activities and parental guidance. Digital disadvantaged students should be given special consideration as they were found to perform worse after taking into account other factors. However, the study has cross-sectional secondary design, proxy measures and no direct measures of hybrid participation, digital competence, social belonging and communication skills. Future studies should test causal pathways more accurately, using validated multidimensional scales and longitudinal designs and data collected specifically from hybrid-learning contexts.

5. Conclusion

This study shows that the digital inequality in hybrid education cannot be seen only from the availability of the internet. Despite being not significantly associated with learning agency or social participation, the digital-inequality proxy negatively predicted examination performance, supporting the hypothesis that digital-inequality is still resulting in academic disadvantages. There was a positive influence of family resources on achievement with a focus on parental education, involvement, income and tutoring support. Motivation, study effort, and attendance (learning agency) were the most significant predictors of achievement, supporting the importance of students' abilities to control and maintain learning in technology-enabled settings. Social participation had a less positive impact on examination performance, which indicates that peer relationships and extracurricular activities could be a means of supporting educational engagement. But digital inequality and family resources did not affect social participation through learning agency. This discovery must be interpreted with care since the secondary data did not directly measure hybrid-learning intensity, digital competence, belonging, communication or social-emotional development in general. All in all, equitable hybrid education goes beyond devices and connectivity. Schools need to combine dependable digital systems, parental involvement, self-directed learning tools, peer support and interaction, and personalized support for

vulnerable students. Future longitudinal studies with multidimensional measures validated by researchers are necessary to explore a causal relationship and to take a more comprehensive look at the social implications of hybrid education.

Reference

1. Alharthi, M. (2023). Parental involvement in children's online education during COVID-19; A phenomenological study in Saudi Arabia. *Early Childhood Education Journal*, 51(2), 345-359.
2. Azubuike, O. B., Adegboye, O., & Quadri, H. (2021). Who gets to learn in a pandemic? Exploring the digital divide in remote learning during the COVID-19 pandemic in Nigeria. *International journal of educational research open*, 2, 100022.
3. Bacher-Hicks, A., Goodman, J., & Mulhern, C. (2021). Inequality in household adaptation to schooling shocks: Covid-induced online learning engagement in real time. *Journal of public economics*, 193, 104345.
4. Baker, L. A., & Spencely, C. (2023). Is hybrid teaching delivering equivalent learning for students in higher education?. *Journal of Further and Higher Education*, 47(5), 674-686.
5. Bo, N. S. W. (2025). OECD digital education outlook 2023: Towards an effective education ecosystem. *Hungarian Educational Research Journal*, 15(2), 284-289.
6. Bond, M., Bedenlier, S., Marín, V., & Händel, M. (2021). Emergency remote teaching in higher education: Mapping the first global online semester (Pre-print).
7. Chiu, T. K. (2022). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of research on Technology in Education*, 54(sup1), S14-S30.
8. Cullinan, J., Flannery, D., Harold, J., Lyons, S., & Palcic, D. (2021). The disconnected: COVID-19 and disparities in access to quality broadband for higher education students. *International Journal of Educational Technology in Higher Education*, 18(1), 26.
9. Golden, A. R., Srisarajivakul, E. N., Hasselle, A. J., Pfund, R. A., & Knox, J. (2023). What was a gap is now a chasm: Remote schooling, the digital divide, and educational inequities resulting from the COVID-19 pandemic. *Current Opinion in Psychology*, 52, 101632.
10. González-Betancor, S. M., López-Puig, A. J., & Cardenal, M. E. (2021). Digital inequality at home. The school as compensatory agent. *Computers & Education*, 168, 104195.
11. Helsper, E. (2021). The digital disconnect: The social causes and consequences of digital inequalities.
12. Lai, J., & Widmar, N. O. (2021). Revisiting the digital divide in the COVID-19 era. *Applied economic perspectives and policy*, 43(1), 458-464.
13. Li, G., Li, B., Wang, L., Liu, C., & Lu, L. (2023). A longitudinal study on the impact of parental academic support and expectations on students' academic achievement: the mediating role of happiness. *European Journal of Psychology of Education*, 38(2), 801-818.
14. Lobos, K., Cobo-Rendón, R., Bruna Jofré, D., & Santana, J. (2024, September). New challenges for higher education: self-regulated learning in blended learning contexts. In *Frontiers in Education* (Vol. 9, p. 1457367). Frontiers Media SA.
15. Lythreath, S., Singh, S. K., & El-Kassar, A. N. (2022). The digital divide: A review and future research agenda. *Technological forecasting and social change*, 175, 121359.
16. Mairitsch, A., Sulis, G., Mercer, S., & Bauer, D. (2023). Putting the social into learner agency: Understanding social relationships and affordances. *International Journal of Educational Research*, 120, 102214.
17. Martinez-Yarza, N., Solabarrieta-Eizaguirre, J., & Santibáñez-Gruber, R. (2024). The impact of family involvement on students' social-emotional development: The mediational role of school engagement. *European Journal of Psychology of Education*, 39(4), 4297-4327.
18. Mathrani, A., Sarvesh, T., & Umer, R. (2022). Digital divide framework: online learning in developing countries during the COVID-19 lockdown. *Globalisation, Societies and Education*, 20(5), 625-640.
19. Miao, J., & Ma, L. (2022). Students' online interaction, self-regulation, and learning engagement in higher education: The importance of social presence to online learning. *Frontiers in psychology*, 13, 815220.
20. Ng, L. (2025). Student performance factors: Insights into student performance and contributing factors [Data set]. Kaggle. <https://www.kaggle.com/datasets/lainguyn123/student-performance-factors>
21. Núñez, J. C., Freire, C., Ferradás, M. D. M., Valle, A., & Xu, J. (2023). Perceived parental involvement and student engagement with homework in secondary school: The mediating role of self-handicapping. *Current Psychology*, 42(6), 4350-4361.
22. Wagner, M., Pishtari, G., & Ley, T. (2025). The role of learning activities and social presence in synchronous hybrid classrooms: results from a natural experiment. *Interactive Learning Environments*, 33(3), 2670-2688.
23. Wang, F., Ni, X., Zhang, M., & Zhang, J. (2024). Educational digital inequality: A meta-analysis of the relationship between digital device use and academic performance in adolescents. *Computers &*

- Education, 213, 105003.
24. Wheele, T., Lindkvist, C., Weber, C., Haugen, T., & Windlinger, L. (2024). Beyond the screen: student experiences of social connection in a hybrid university learning environment. *Learning, Media and Technology*, 1-16.
 25. Xiong, Y., Qin, X., Wang, Q., & Ren, P. (2021). Parental involvement in adolescents' learning and academic achievement: Cross-lagged effect and mediation of academic engagement. *Journal of Youth and Adolescence*, 50(9), 1811-1823.
 26. Yang, D., Chen, P., Wang, K., Li, Z., Zhang, C., & Huang, R. (2023). Parental involvement and student engagement: a review of the literature. *Sustainability*, 15(7), 5859.