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STUDY

IF THEY TALK MORE DURING LESSONS, WILL THEY ACHIEVE BETTER? UNLOCKING THE RECIPROCAL RELATIONSHIP BETWEEN STUDENT VERBAL PARTICIPATION AND ACHIEVEMENT

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ABSTRACT

This study investigates the relationship between student verbal participation and achievement in sixth-grade language arts. We conducted an intervention in six classes to enhance and equalize student talk while reducing individual disparities in participation. The design of the study involved measuring talk time and administering reading literacy tests before and after the intervention, with similar measurements in six control classrooms. The results indicated increased and more evenly distributed verbal participation in the intervention classrooms than in the control classrooms. However, no significant differences in student achievement were observed between the two groups. A path analysis examined the link between participation and achievement, confirming that verbal participation is a predictor of student success. The study suggests that the impact of increased verbal participation on achievement might be more pronounced over the long term, necessitating further research with delayed post-measurements to fully understand this relationship.

KEY WORDS

student talk; student achievement; reading literacy test; intervention study; path analysis; post covid study

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Introduction

The question of how to provide high-quality instruction for all students is central in the field of educational sciences. It is believed that actions taken within the school environment exert a considerable influence on the disparities in student academic performances within various social and economic settings (Morlà-Folch et al., 2022). Research into how to help all students improve their educational outcomes regardless of their socioeconomic background is very much alive, with mounting evidence indicating that factors at the classroom level have a greater capacity to account for variations in student achievement than factors at other levels (Panayiotou et al., 2021; Kyriakides et al., 2020).

Research at the classroom level often emphasizes the effective instructional practices of teachers; the understanding of student roles in instructional processes is less emphasized (Schenke, 2018). However, it has been credibly confirmed that student engagement and participation matter and are decisive for student outcomes (Bae & DeBusk-Lane, 2019; Chang et al., 2016; Decristan et al., 2023; Schnitzler et al., 2020). In this study, we view teacher and student practices as complementing each other in co-constructing the quality of instruction in the classroom.

Classroom talk during whole class teaching and the role of students within it is a primary focus of this study. It has been repeatedly found that classroom dialogue matters for students and that optimal patterns of classroom talk can enhance student achievement (Alexander, 2018; Hardman, 2016; Howe et al., 2019). Additionally, studies have shown that individual students in the class benefit differently from classroom dialogue depending on how intensively they participate in classroom discourse (Šeďová et al., 2019; Decristan et al., 2023; Ing et al., 2015; Neuman et al., 2021; Rüede et al., 2023; Schnitzler et al., 2020; Webb et al., 2014). Based on the findings from these studies, we closely examine the link between student verbal participation and student achievement. We want to confirm the existence of the link and to explore the potential for utilizing the link to enhance student learning and performance. We conducted an intervention project aimed at equalizing verbal participation among sixth-grade students. By analyzing data on student verbal participation in language arts lessons and their performance in literacy tests, we aim to determine whether it is possible to influence student outcomes through an increase in their verbal participation.

1 Individual differences in student participation in classroom discourse

Student participation in classroom discourse has been extensively studied in the past decade. It has been operationalized through students' verbal contributions, including the frequency and length of those contributions (Clarke, 2015; Decristan et al., 2023; Helgevold, 2016; Jurik et al., 2013; O'Connor et al., 2017; Šeďová et al., 2019), as well as various forms of signaling student intent to participate, such as hand-raising and calling out (Böheim et al., 2020; Decristan et al., 2023; Mundelsee & Jurkowski, 2021; Orner & Netz, 2023; Schnitzler et al., 2020). A unanimous finding across these studies is the wide variation in participation among individual students in the classroom. Some students are vocal and keen to take the floor; others are less engaged. A significant group of students remains completely non-participatory. A recent large study from Germany (Decristan et al., 2023) found that approximately 30% of students neither spoke nor raised their hands during observed lessons.

Student participation in classroom talk is associated with several factors. Those who participate more in class have been found to have higher socioeconomic status (Kelly, 2008; Orner & Netz, 2023; Šeďová & Sedláček, 2023), to be extroverted (Caspi et al., 2006; Young, 2014), to be motivated to learn (Böheim et al., 2020; Jurik et al., 2013), and to have a high academic self-concept (Kawabe et al., 2014; Schnitzler et al., 2020). The most recurrent finding is that high-participating students are those who achieve higher grades and have more prior knowledge (Clarke, 2015; Decristan et al., 2023; Myhill, 2002; Kelly, 2008; Jurik et al., 2013; Šeďová et al., 2019). Altogether, this stream of research portrays the image of a "good student" who possesses sufficient cultural and social capital and therefore seizes the opportunity to participate in class discussions.

2 Effects of participation for student learning

Classroom discourse has been demonstrated to have a positive impact on student outcomes. Research studies have shown that students who actively participate in classroom discourse tend to achieve greater learning gains. Webb et al. (2014) and Ing et al. (2015) found that students who frequently developed their own ideas in conversations and explained them to others during math lessons achieved better results in math tests. Šeďová et al. (2019) discovered that students with higher talk time and more utterances with argument time during language arts lessons performed better in reading literacy tests. Neuman et al. (2021) conducted a study in which they found

that the number of conversational turns during a lesson predicted statistically significant improvements in young children's vocabulary scores. Schnitzler et al. (2020) discovered that students who raised their hands more frequently achieved better results in end-of-year assessments. Decristan et al. (2023) found that students who raised their hands and actively participated in discussions during math and science lessons achieved better scores in math and science tests. According to a study by Rüede et al. (2023), the number of productive discourse moves initiated by students during math lessons showed a positive correlation with their performance on math tests.

All these results are impressive, but it cannot be overlooked that the operationalization of participation differs heavily across these studies. Further, there have been studies that did not confirm this link between participation and achievement: Inagaki et al. (1998) and O'Connor et al. (2017). Therefore, exploring the link between participation and achievement still deserves systematic focus.

Another underexplored aspect of the cited studies is the problem of causality. The studies confirming that those who participate more learn more did not control for the possibility that the link has the reverse direction. Some researchers have provided evidence that high achievers and students with prior knowledge participate more (Clarke, 2015; Decristan et al., 2023; Myhill, 2002; Kelly, 2008; Jurik et al., 2013; Šeďová et al., 2019). Therefore, the link between participation and achievement must be carefully examined with both causal possibilities considered.

3 Equitable participation as a tool for enhancing achievement of all students

Given what is known about the positive link between individual participation in classroom discourse and student achievement (Decristan et al., 2023; Ing et al., 2015; Neuman et al., 2021; Rüede et al., 2023; Schnitzler et al., 2020; Šeďová et al., 2019; Webb et al., 2014), it is necessary to address who is given the opportunity to talk and be heard in class. In this sense, Vrikki et al. (2019) called for equitable participation, which they understood as ensuring that all students have equal opportunities to engage in and contribute to classroom discourse. Similarly, we advocate collective classroom dialogue as a tool for equalizing learning opportunities for students and mitigating educational inequalities resulting from student socioeconomic backgrounds (see Šeďová et al., 2019; Šeďová & Sedláček, 2023).

In this light, it is surprising intervention studies striving to enhance the participation of all students are scarce. To our knowledge, there have been only two: Sedláček & Šeďová (2020) and Moser et al. (2022). In both studies,

a professional development program was conducted that focused on improving classroom dialogue. Researchers, apart from other measurements, observed the number of students verbally participating in post-intervention lessons. Both studies were only partially successful in increasing the number of participating students, and neither study controlled for changes in student achievement.

This creates a significant research gap, which we aim to address in this study. We want to determine whether the increase in student verbal participation after the intervention will be followed by an improvement in student achievement. Additionally, we want to examine the link between participation and achievement by investigating which of these variables serves as the predictor for the other.

4 Methodology

4.1 Research design

The research design was a quasi-experiment, as a random selection of intervention and control classes was unfeasible. Our study aims to assess the impact of intervention to increase student verbal participation in language arts lessons on reading literacy achievement. We designated specific classes as "intervention" classes; their selection was contingent upon the willingness of the respective schools and teachers to participate in the intervention program. In total, six intervention classes from four mainstream schools in the South Moravian region were recruited for this study. All schools were characterized by mainstream curricula and the absence of tracking practices. It is noteworthy that all schools in our study received a "good" rating from the Czech School Inspectorate, with none falling into the categories of "excellent" or "below average." The schools with "control" classes were randomly selected from a predefined list of schools within the same region, sharing similar ratings and student enrolment figures. Data collection in both the intervention and control groups of classes was based on observations and video recordings in Czech language lessons and language arts lessons.

4.2 Intervention program and sample

The intervention was designed for Czech language teachers, with all activities subsequently implemented in their classrooms. The program included five group workshops for teachers, collaborative lesson planning conducted within teacher-researcher pairs (n = 5), video recordings of lessons during the intervention (n = 5), and video-stimulated reflections on these lessons within the teacher-researcher pairs (n = 5). Their training focused on the implementation of specific teacher talk moves, including encouraging student

ideas, facilitating students building upon these ideas, promoting reasoning, extending ideas, and posing challenging questions. These practices were inspired by the T-SEDA framework (https://www.educ.cam.ac.uk/research/programmes/tseda). Teachers were trained to focus talk moves on individual students and to be sensitive to giving support to students who stay silent or hesitate to participate. Throughout the workshop sessions, a central emphasis was placed on creating a safe and supportive classroom environment, as well as acquainting students with the importance of active listening and respecting their peers' contributions. In addition to their workshop attendance, from November 2021 to May 2022, all participating teachers collaborated in pairs with researchers. Their task involved preparing five consecutive lessons, each incorporating support of equitable participation. Before each lesson, a planning session was conducted by the teacher-researcher pairs to outline the instructional approach. Subsequently, the lessons were video recorded by the researcher. Following each lesson, a reflective session was held within the teacher-researcher pairs. During these sessions, both teacher and researcher jointly reviewed video clips from the lesson, focusing on how equitable student participation was and how the teacher supported it. Notably, these sessions provided talk time measurements for all students present during the video-recorded lesson. This allowed teachers to gain a comprehensive overview of their success in involving all students in the classroom discourse.

As mentioned above, the sample consisted of six intervention classes and six control classes. All classrooms were sixth grade, with students aged eleven to twelve years. A total of 276 students participated in the study: 145 in intervention and 131 in control classes. There were no significant differences in composition (gender, native language, socioeconomic status) between the class groups (Table 1).

Table 1
Characteristics of the sample

Intervention classes	*N* (%)
Girls	77 (53.0%)
Boys	68 (47.0%)
Other native language	7
ESeCa (working class)	20
Control classes	
Girls	57 (44.0%)
Boys	74 (56.0%)
Other native language	5
ESeCa (working class)	26

4.3 Measures

4.3.1 Talk time

We measured the quantity of talk time in the classroom, i.e., the aggregate amount of time for which a particular student spoke during the lesson in the whole class conversation related to the curriculum. The individual student talk time was calculated as the average in seconds from the two lessons taught before the start of the program ("talk time 1") and the two lessons taught after the end of the program ("talk time 2"). Teachers were instructed to teach the lessons in their usual way. All lessons lasted 45 min (2,700 s). The student talk time was not calculated from the total time of the lesson. We excluded all situations unrelated to the curriculum of the lesson, such as organizational issues and classroom management. We also excluded the parts of the lessons in which whole-class conversation did not take place, such as during individual or group student work. We then excluded the times when the whole class was reading aloud. This left us with the time dedicated to the curriculum that was relevant for whole-class conversation – the average time was 21 min (1,260 s) per lesson. Of this amount, teachers averaged about 16 min (967 s) and the students a total of 5 min (300 s) per lesson.

4.3.2 Achievement in reading literacy

The literacy tests used in this research were developed by Scio, a company that provides a system of national comparative exams for schools in the Czech Republic. We employed two versions of standardized tests, hereafter referred to as "achievement 1" and "achievement 2". These tests contained identical types and numbers of tasks, including distinguishing fact from opinion in a reading text, recognizing manipulative communication, formulating the main idea of a text, and organizing information in a text with respect to its purpose. Specific task examples are provided in Annex 1. The tests did not feature the same anchor tasks, and students completed the tests with a seven-month gap between them. The test comparability was ensured by maintaining consistent difficulty and sensitivity levels for the tasks across both test versions. Task selection was based on Scio's task database for national comparison tests, allowing for the utilization of psychometric properties from previous waves of national comparison tests for the same age group.

4.4 Data analyses

In this paper, we examine two main questions: 1. Has the intervention program been successful in influencing achievement in reading literacy? 2. What is the relationship between talk time and achievement in reading literacy, i.e., is talk time a predictor of achievement, or is it the other way around?

Statistical analyses consisted of independent samples t-test to verify differences in the scores of the reading literacy test between intervention and

control classes. A paired samples test was used to compare the differences in test results in the first and second wave of testing ("achievement 1" and "achievement 2"). We applied analysis of covariance (ANCOVA) to assess the impact of an intervention while accounting for pre-existing differences among students. The covariates were the results before the intervention ("achievement 1") and the change in talk time. We tested two models assuming different relationships between talk time and achievement with path analysis using IBM SPSS AMOS 29. We posited that "talk time 1" positively influences performance in reading literacy assessments ("achievement 1"). Subsequently, "achievement 2" is explained by "talk time 2" and "achievement 1". In Model 2, we posited the opposite direction: students with better achievement talk more frequently in instructional communication. The model fit was examined using the chi-squared test ($\chi 2$) and its degree of freedom, the Root Mean Square Error of Approximation (RMSEA; values of 0.08 or less), the Comparative Fit Index (CFI; values greater than or equal to 0.95), and the Standardized Root Mean Square Residuals (SRMR; values of 0.08 or less) (Hu & Bentler, 1999).

4.5 Research ethics

We first sought oral consent from the school principals and all the teachers to allow us to conduct the research in their schools and classrooms. In the next step, we sought written consent from the teachers and afterward we asked for the written consent of all the parents of the students participating in the observed classes. Participants were assured of confidentiality and of the ability to withdraw at any time. Five parents in the intervention classes and 13 parents in the control classes decided not to agree with their children's involvement in the research. These students were present in the class during the recorded lessons but they sat outside of the camera's frame of vision and their talk time was not measured.

All participants were assigned numbers, and any personally identifying information was removed from the data prior to analysis.

5 Results

5.1 Impact of talk time on achievement in reading literacy

The primary goal of the intervention program was to enhance talk time within the class and at the same time to equalize talk time among individual students. The intervention program was successful in this regard. The analysis was based on comparisons of the individual student talk time before the program ("talk time 1") and after the end of the program ("talk time 2"). In the intervention classes, "talk time 1" and "talk time 2" exhibited a significant

difference, with an increase in "talk time 2" (Wilcoxon signed ranks T, $p < 0.001$). Conversely, no significant increase was observed in the control classes (p=0.12). A notable effect of the intervention was the reduction in individual differences in "talk time 1" compared to "talk time 2". This reduction is evidenced by a decrease in the coefficient of variation of approximately 30%. In this paper, we investigate whether changes in individual students' talk time correlate with their improvements in reading literacy, as detailed in Table 2.

Table 2
Descriptive statistics for talk time and reading literacy test

Measure	*N* (valid)	Min	Max	Mean		*SD*
				Statistic	*SE*	
Intervention classes						
talk time 1	124	0.00	85.02	11.87	1.29	14.55
talk time 2	138	0.17	98.48	17.45	1.43	16.82
achievement 1	130	3.85	96.15	52.11	1.73	19.82
achievement 2	125	19.23	100	59.55	1.64	18.33
Control classes						
talk time 1	115	0.00	103.18	12.95	1.57	16.89
talk time 2	126	0.00	111.85	14.38	1.54	17.23
achievement 1	100	3.85	92.31	47.75	1.91	19.11
achievement 2	112	11.54	96.15	52.82	1.81	19.14

Note: Talk time – individual student talk time (average per one lesson in seconds); achievement – reading literacy (success in %).

Comparing "achievement 1" and "achievement 2" in the intervention and control classes is essential. It is important to note there were no significant differences in the composition of the intervention and control classes in terms of gender, socioeconomic status, or ethnicity (as indicated by the number of students with a different native language). Before the intervention (i.e., "achievement 1"), the average success rate was higher in the intervention classes, with a mean percentage success rate approximately 5% higher than in the control classes (approximately 48% and 52%). However, with equal variance in both class groups, this difference was not statistically significant (ANOVA, $F = 3.707$, $p > 0.05$). A substantial shift in "achievement 2" was observed in both class groups, with significance (Paired Samples Test, $t = 5.05$, $p < 0.01$; $t = 2.81$, $p < 0.05$). This growth was expected, due to student maturation and the effects of schooling. Comparing the means in the

intervention and control classes, as in the previous wave, pupils in the intervention classes achieved better results. The difference was approximately 7% (approximately 53% and 60%), and it was statistically significant (ANOVA, $F = 7.465$, $p < 0.05$).

Comparing the mean success rate in the control and intervention classes indicates that the intervention indeed affected reading literacy achievement. This analysis has a limitation: it only compares achievement in these two groups without considering changes in talk time. To address this, differences in "achievement 2" literacy between the control and intervention classes are further confirmed through a two-way ANCOVA. The independent factor is the intervention, and the model includes a covariate represented by "talk time 2" along with "achievement 1" as a control covariate. ANCOVA offers a more refined estimate of the intervention's impact on "achievement 2" by eliminating the influence of other variables. We present the results in Table 3. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, or reliable measurement of the covariate.

Table 3
Tests of Between-Subjects Effects. Dependent variable: achievement 2

Source	Type III Sum of Squares	*df*	Mean Square	F	Sig.	Partial Eta Squared
corrected model	26320.334[a]	7	5264.067	24.112	0.000	0.386
intercept	11226.116	1	11226.116	51.422	0.000	0.211
intervention	503.376	1	503.376	2.306	0.131	0.012
achievement 1	12409.039	1	12409.039	56.840	0.000	0.228
talk time 2	4.524	1	4.524	0.210	0.886	0.001
intervention* achievement 1	41.029	1	41.029	0.186	0.666	
intervention* talk time 2	2.819	1	2.819	0.013	0.910	
achievement 1* talk time 2	10.677	1	10.677	0.049	0.826	
intervention* talk time 2* achievement 1	4.894	1	2.447	0.011	0.989	0.000
error	41916.236	192	218.314			
total	711821.321	198				
corrected total	68236.570	197				

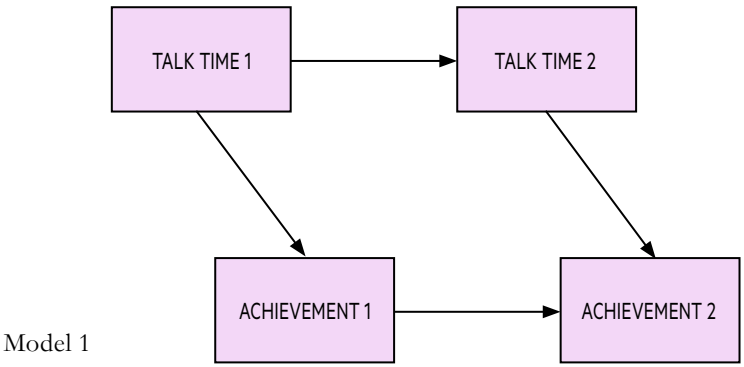
[a] *R* Squared = .386 (Adjusted *R* Squared = .370)

The ANOVA results indicate that intervention, as a predictor of "achievement 2" in reading literacy, loses its significance when controlling previous success rates in reading literacy ("achievement 1") and actual talk time ("talk time 2"). This is evidenced by the nonsignificant p values of the predictors and their interactions. The only statistically significant one is the initial performance of students, naturally. What does this suggest? Looking again at the descriptive indicators (Table 1), student talk time increased substantially in the intervention classes. There was no such change in the control classes. Achievement in reading literacy changed in both groups. Due to natural progression, students improved. In the intervention classes, the improvement is slightly higher. However, the improvement is less significant than the change in talk time. Thus, it seems that the changes in talk time did not have a definitive effect on achievement. What is the link between achievement and talk time?

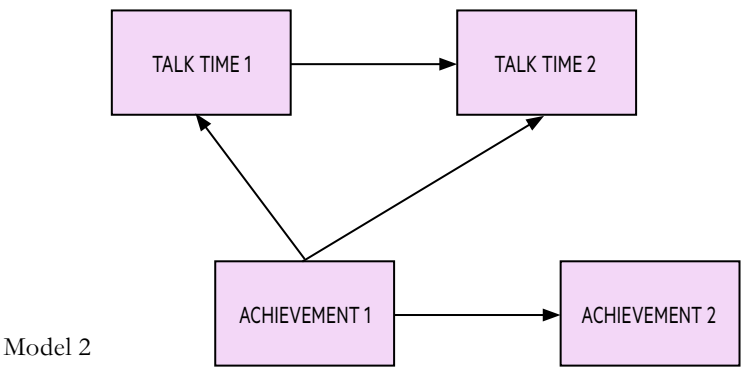
5.2 Is talk time a predictor of achievement, or is it the other way around?

The longitudinal nature of the data from our intervention study makes it possible to verify the multivariate relationships between student talk time and student achievement through path analyses. We assume that student talk time predicts student achievement and not vice versa. We test models defining different possibilities of relationships between variables. The aim is to identify which one best fits the data. In baseline Model 1 (see Figure 1), we assume that talk time in lessons of language arts ("talk time 1") positively predicts performance on reading literacy tests ("achievement 1"). Subsequently, "achievement 2" is explained through "talk time 2" and "achievement 1". However, the relationship between student talk time and student achievement may work in such a way that students with better achievement also talk in instructional communication more frequently. This is estimated in Model 2, where we reverse the direction of the association between "achievement 1" and "talk time 2" for this reason.

For the models, we use data from the full sample; that is, we combine intervention and control classes. Table 4 shows the basic characteristics of the variables entering the models.



Model 1



Model 2

Figure 1
Variants of models for path analysis

Table 4
Means and correlations among all variables selected for the path analysis

Variable	*N* (valid)	*M* (*SD*)	Correlation			
			1	2	3	4
1. talk time 1	239	12.4 (15.7)		0.24**	0.16*	0.14*
2. talk time 2	264	15.9 (17.1)	0.24**		0.10	0.05
3. achievement 1	221	49.9 (19.8)	0.16*	0.11		0.61**
4. achievement 2	237	56.4 (18.9)	0.14*	0.05	0.61**	

Note: Talk time – individual student talk time (average per one lesson in seconds); achievement – reading literacy (success in %). Pearson correlations: statistically significant at an alpha level *< 0.05; **< 0.01

It is clear from the mean values for both talk time and achievement variables that there were increases in both characteristics over the period. The reasons for the increases are explained in the previous question. Zero-order correlations show that the closest correlation is between "achievement 1" and "achievement 2". Other correlations, although not as strong, also confirm that testing the models outlined above through path analysis is meaningful.

Path analysis makes it possible to see the substantial direct and indirect effects of interactions between variables. At the same time, we can compare multiple options and decide which best fits the data based on their fit parameters. We used the Akaike information criterion (AIC) and Bayesian information criterion (BIC) to compare models. We held to the basic rule that a model with lower AIC and BIC is more appropriate for the data (cf. Raftery, 1995). We offer the basic results of the two hypothetical models in Table 5.

Table 5
Fit indices of path analysis

							Our model		Saturated model	
Fit indices	χ^2	*df*	*p*	CFI	TLI	RMSE	AIC	BIC	AIC	BIC
Model 1	2.03	2	0.36	0.95	0.99	0.07	26.026	26.470	28.000	28.599
Model 2	7.472	3	0.05	0.91	0.86	0.08	29.472	29.879	28.000	28.519

Note: CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; AIC = Akaike's information criterion; BIC = Bayesian information criterion.

We tested the direct path from talk time to student achievement in Model 1. The hypothesis that student achievement directly affects talk time was estimated in Model 2. According to the results of the chi-squared test and different structural equation modeling (SEM) criteria commonly used for SEM evaluation, Model 1 better fit the data. The statistical significance of the chi-squared test for Model 2 is crucial in this regard. The result indicates that we must reject the null hypothesis if the estimated model fits our data. For Model 1, on the other hand, we can maintain this hypothesis. The unsuitability of Model 2 was also confirmed by the information criteria (AIC and BIC). Here, for each of the models, the comparison of the estimated model (ours) with the so-called saturated model is essential. This is the model with the maximum number of parameters. Our model should always have lower values (the AIC and BIC values are always compared separately).

Model 2 does not meet this assumption. Model 1, on the other hand, shows good values of the other SEM criteria. The fit indices (AGFI, CFI, and TLI) were above the level of 0.95, considered a very good fit. On the other hand, the RMSEA measuring the misfit of the model only attained a threshold value of 0.08 (Kline, 2005).

Table 6
Unstandardized path coefficients, standard errors, and t-values for Model 1

Path	Estimate	*SE*	*t*	*p*
talk time 1 to achievement 1	0.209	0.086	2.432	<0.05
talk time 1 to talk time 2	0.283	0.068	4.180	<0.01
achievement 1 to achievement 2	0.598	0.051	11.811	<0.05
talk time 2 to achievement 2	0.005	0.059	0.081	0.93

Model 1 exhibits a relatively good fit to the data; however, it is on the border of acceptability. A detailed examination of the unstandardized coefficients and their statistical significance, as presented in Table 6, reveals that there is no significant relationship between "talk time 2" and "achievement 2". This means that the expected association between the repeated measure of talk time and the second reading literacy test does not exist within Model 1. Nevertheless, Model 1 does support the hypothesis that, in the absence of an intervention, "talk time 1" does indeed influence student "achievement 1". To refine our analysis, we adjusted Model 1. This involved removing an ineffective link and introducing a direct connection between "talk time 1" and "achievement 2". Talk time 1 is considered a long-lasting characteristic and is expected to directly impact student achievement, even with a longer time lag.

Table 7
Fit indices of path analysis (Model 3)

							Our model		Saturated model	
Fit indices	χ^2	*df*	*p*	CFI	TLI	RMSE	AIC	BIC	AIC	BIC
Model 3	0.637	2	0.73	0.99	1.06	0.00	24.63	25.08	29.000	28.519

Note: CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; AIC = Akaike's information criterion; BIC = Bayesian information criterion.

We summarize the results of this final model in Table 6. We described the SEM criteria showing a good fit to the data. From the results presented in Table 6, Model 3 indicates an excellent fit. Compared to Model 1, the change in the RMSE criterion (0.00) is particularly significant, marking a low misfit in the final Model 3. Therefore, we consider Model 3 as the final model. The correlations and their strength as represented by the standardized beta coefficients are presented in Figure 2.

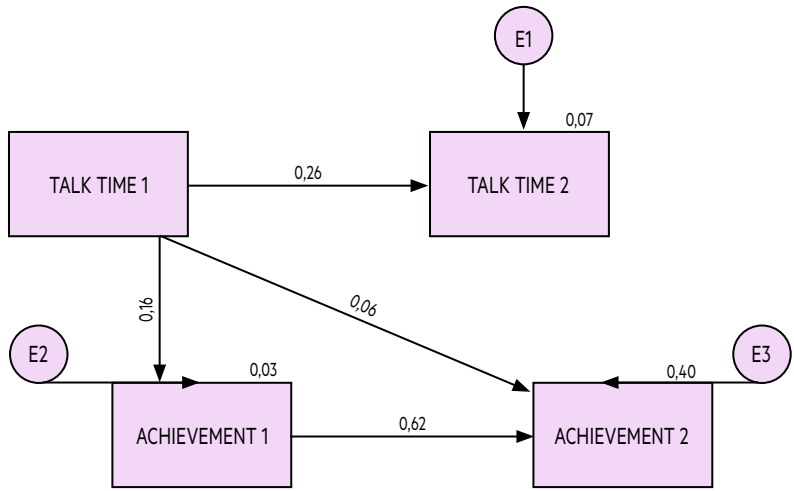


Figure 2
Results for final model relating participation in classroom discourse and student achievement with standardized coefficients

Source: IBM SPSS AMOS

In the final model, the outcome variable ('achievement 2') is explained by all included factors, with an Adjusted R^2 of approximately 40%. This is a perfect result. The other endogenous variables of the model do not reach such values. The first round of student achievement measurement is explained at 3%. The resulting R^2 for the second measurement of participation in classroom discourse ("talk time 2") reached a value of 7%. In both cases, this was due to only one predictor: the initial characteristic of participation in classroom discourse ("talk time 1"). The more detailed analysis allows us to analyze the direct, indirect, and total causal effects of variables. We summarize the results in Table 8.

Table 8
Direct, indirect, and total effects (standardized) for the path model

Path	Direct effect	Indirect effect	Total
Talk time 1 to achievement 1	0.205	0.000	0.205
Talk time 1 to talk time 2	0.281	0.000	0.281
Achievement 1 to achievement 2	0.588	0.000	0.588
Talk time 1 (via achievement 1) to achievement 2	0.077	0.163	0.240

The most critical finding confirms the direct positive effect of talk time on student achievement. Higher talk time means improving achievement in reading literacy. In the first round of measurement, the strength is expressed by a standardized regression coefficient of 0.16 (the unstandardized regression coefficient has a value of 0.21, which, given the units of measure, can be interpreted as meaning that an increase of 5 seconds means a 1% better success rate in the test). The confirmed relationships between the first and second rounds of measurement for both student talk times and achievements are logical, given the pairing of the measure.

The second significant finding does not confirm the connection between "talk time 2" and "achievement 2". This lack of association can be attributed to the relatively short time between measurements. It appears that changes in talk time did not have a significant impact on achievement within this timeframe. It is worth noting educational changes typically exhibit longitudinal patterns (Larraín et al., 2018); this is supported by our observation of the relationship between "talk time 1" and "achievement 2". The initial characteristic of student "talk time 1" has a lasting influence on "achievement 1," demonstrating a strong connection. Although the direct influence on "achievement 2" is relatively weak (0.06), this link is bolstered indirectly through its effect on "achievement 1" (0.163). Consequently, the overall impact of "talk time 1" on "achievement 2" remains substantial and statistically significant (0.240). These findings strongly suggest that changes in "talk time 2" are likely to manifest in future academic achievements, specifically "achievement 3".

6 Discussion

The present study is the first to investigate the link between student participation in classroom discourse and student achievement within the frame of an intervention program focused on increasing and equalizing

student participation. Although several intervention projects have been conducted to influence student achievement by changing the quality of classroom discourse (Alexander, 2018; Hardman, 2016; Howe et al., 2019; Ruthven et al., 2017) none of them has yet taken into account individual differences among students.

There is some evidence indicating a positive relationship between individual participation in classroom discourse and student achievement (Decristan et al., 2023; Ing et al., 2015; Neuman et al., 2021; Rüede et al., 2023; Schnitzler et al., 2020; Šeďová et al., 2019; Webb et al., 2014); however, none of the previous studies was designed to control the causality in this link. The interventional nature of our data allowed us to test two models, one expecting achievement to be affected by talk time and the second expecting talk time to be affected by achievement. Simply said, we asked whether students perform better due to their extensive talk or talk more due to their good achievement. Our analysis confirmed the first model to better fit the data: the quantity of student verbal participation predicts their achievement.

The effect size of talk time is quite small, but it is a piece in the mosaic of other findings confirming the predictors of student achievement (Hattie, 2009; King et al., 2024; Mullis et al., 2001; Terhart, 2011). Determining the predictors of achievement is essential in education as it makes it possible to think about how to create conditions for students that will increase their chances of success. Some of the recognized predictors cannot be influenced – such as socioeconomic background, previous schooling, and prior achievement. Others can be – including learning motivation and academic self-concept – but it is a complex and challenging task. Student participation in classroom discourse is prone to change in stimulative conditions, as evidenced by our data. Therefore, it deserves the careful attention of educators.

Our findings imply that teachers should invite all students to participate in classroom discourse for the sake of their learning. The goal is to equalize the uneven participation opportunities for different students in the same class (Vrikki et al., 2019). It has been established that students who are both silent and disengaged face learning challenges (Bae & DeBusk-Lane, 2019; Schnitzler et al., 2020). Therefore, a key task for teachers is to assist these students in finding their voices, thereby enhancing their learning opportunities. This becomes particularly relevant in the Czech educational culture, where students are expected to be attentive but not necessarily outspoken (see Šeďová & Sedláček, 2023). To ensure effective learning for all students, it is essential to challenge and move beyond these traditional norms.

Our analysis showed that students who had participated in an intervention enhanced their performance in literacy tests more than students in control classes. However, the change in achievement was not adequately large

compared to the change in participation. This difference raises the question of what this result means considering the finding that talk time predicts achievement. We hypothesize that the change in verbal participation needs more time to be reflected in student achievement. This hypothesis may be supported by the fact that achievement in post-measurement was more affected by the talk time before the intervention than at the end of the intervention.

Student participation has been found to be structured into quite stable patterns co-created by students, teachers, and peers in the classroom (Kovalainen & Kumpulainen, 2007; Šeďová & Sedláček, 2023). The influence of talk on achievement is thus long standing. It can be assumed that talk does not have an immediate effect, but rather a long-term cumulative impact. The intervention we conducted in participating classrooms led to a reconstruction of participation patterns with a strong participation elevation in the previously silent students and a mild decrease in the previously most vocal students. Several future scenarios could be relevant. First, the new participation patterns become stable and after some time the increased participation transforms into improved performance. Second, new participation patterns will evaporate when not supported by the intervention team and therefore there will be no change in achievement. Third, the new participation patterns will survive due to teacher commitment to equitable participation, but they will not affect student learning.

These three possible scenarios outline the agenda for future research. It is important to continue investigating the potential influences of student participation in classroom discourse, as recent findings are promising and indicate easy-to-implement tools for enhancing student learning. When designing future studies, it is necessary to include long-term monitoring of both student participation and student achievement. Only through delayed post-measurements can we find whether promoting verbal participation could be conducive to changes in their achievement.

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