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ORIGINAL RESEARCH

How vocal and silent forms of participation in combination relate to student achievement

Klara Sedova[1] · **Martin Sedlacek**[1]

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Abstract

We adopted a person-oriented approach to identify patterns of how classroom talk and internal behavioral engagement are combined in students.

The research was conducted on a sample of 639 ninth-grade students (32 classes). We measured the duration of classroom talk for each individual student during Czech language and language arts lessons. The students completed an inventory to determine their internal behavioral engagement. Student achievement was measured using the results from standardized reading literacy tests. We also inquired about the socioeconomic backgrounds of the students.

We identified five distinct participation profiles (eager, chatty, diligent, aloof, and disconnected) and analyzed whether the profiles could predict student achievement. We found that the profile with high talk and high internal behavioral engagement performed best, and the profile with low talk and low internal behavioral engagement performed worst. Analyzing the inconsistent profiles, we found that high internal behavioral engagement did not guarantee student achievement if the engagement was not accompanied by talk. Our findings thus highlight the important role of classroom talk in relation to student learning.

Introduction

Classroom talk has recently been recognized as deserving intense scholarly focus. The importance of the quality of classroom discourse is being highlighted, especially in relation to student learning and achievement (see for example Resnick et al., 2015). Some studies have indicated that students who intensely verbally participate in class achieve better results than their less vocal schoolmates (Sedova et al., 2019; Ing et al., 2015; Larrain et al., 2019; Webb et al., 2014).

At the same time, a number of studies have examined student engagement as a commitment or investment in the student's learning activities (Fredricks et al., 2004), finding

✉ Klara Sedova
ksedova@phil.muni.cz

[1] Department of Educational Sciences, Faculty of Arts, Masaryk University, Arna Novaka 1, 602 00 Brno, Czech Republic

a positive link between engagement and student achievement and academic success (e.g., Fredricks et al., 2004; Chang et al., 2016; Wang & Eccles, 2012; Zumbrunn et al., 2014).

This raises the question of whether student talk in classrooms is determinative in and of itself. Do those who talk more learn more due to their talk? Or do they learn more due to their engagement, which manifests itself, among other things, through their participation in classroom talk? Can the silent students be as successful as the vocal ones if they are committed to learning and they try hard?

In this study, we analyzed both student classroom talk and student internal behavioral engagement at the same time. We adopted a person-oriented approach to uncover patterns in how classroom talk and internal forms of behavioral engagement were combined in students. Further, we investigated whether particular combinations of talk and internal engagement could predict student achievement. We used data from Czech schools, which tend to follow traditional teaching styles and are not generally dialogue-rich environments. Students are expected to pay attention in silence and only briefly answer teacher questions when they are asked (Sedova et al., 2014). In the context of such cultural norms, our questions about the benefits of silent and vocal participation are extremely pertinent.

Behavioral engagement as a predictor of student success

Student engagement can be understood as a student's commitment to or investment in learning activities (Fredricks et al., 2004). It is conceived as a meta-concept that includes behaviors, cognitions, emotions (Fredricks et al., 2004), and social interactions (Wang et al., 2018). Engagement is important for student learning; a number of recent studies have shown a positive link between engagement and student achievement and academic success (e.g., Bae & DeBusk-Lane, 2019; Chang et al., 2016; Schnitzler et al., 2020; Wang & Degol, 2014; Wang & Eccles, 2012; Zumbrunn et al., 2014).

As stated by Fredricks et al. (2016) and Wang et al. (2018), engagement consists of four distinct but interrelated components: behavioral (involvement in academic activities), emotional (emotions toward teachers, classmates, and learning content), cognitive (self-regulation, persistence, and effort in learning), and social (quality of social interactions in class). In this study, we decided to focus solely on behavioral engagement. Behavioral engagement consists of student participation in class-based activities, attention and concentration, adherence to classroom rules, and homework completion (Fredricks et al., 2004). According to Skinner et al. (2009), behavioral engagement captures the quality of student participation in learning activities in the classroom, ranging from energized, enthusiastic, focused, and emotionally positive interactions with academic tasks to apathetic withdrawal. These characterizations make it easy to understand how behavioral engagement can be an important predictor of student achievement. Simply put, being behaviorally engaged means utilizing the learning opportunities that emerge in the classroom.

Although behavioral engagement is only one dimension of global engagement, we believe it to be a very important one. Bae and DeBusk-Lane (2019) used the person-oriented approach to identify unique combinations of individual engagement components in students. They revealed several consistent engagement patterns – behavioral, cognitive, and emotional components were usually similarly high or low. They also revealed two inconsistent patterns. In these patterns, behavioral engagement was in opposition to other engagement components, with behavioral engagement high and cognitive and emotional engagement

low, or with cognitive and emotional engagement high and behavioral engagement low. Moreover, when Bae and DeBusk-Lane (2019) analyzed links between engagement patterns and student achievement, they found behavioral engagement to be more predictive than the other two components. This observation indicates that it is necessary to focus on behavioral engagement in greater detail.

Behavioral engagement takes both external and internal forms. By external forms, we mean visible behavior, including students talking, raising hands, and taking notes. There have been studies focused on these manifestations of behavioral engagement that used observational designs (Dixon et al., 2009; Goldberg et al., 2019; Goldin et al., 2019; Schnitzler et al., 2020). However, behavioral engagement also takes internal forms, such as students paying attention, putting effort into tasks, and concentrating on instructions. These internal forms are non-observable and can be studied only through self-reporting measures in which students rate their engagement in classroom activities (see Fredricks & McColskey, 2012). In this study, we examined both forms of behavioral engagement using data from class observations and data from student questionnaires.

A link between student classroom talk and achievement

Student classroom talk can be classified as a display of behavioral engagement. Several studies have confirmed a positive impact for students located in "talk intensive" classes in which students speak often, are involved in deep and meaningful conversations, and have supportive teachers (Alexander, 2018; Muhonen et al., 2018; O'Connor et al., 2015).

However, it is questionable whether all students in the classroom benefit from classroom discourse in the same way. A hypothesis has emerged that vocal students could be more effective in utilizing learning opportunities stemming from classroom talk. Some studies have supported this assumption.

A study conducted in mathematics lessons on a sample of 111 students (ages 8 to 10) by Webb et al. (2014) and Ing et al. (2015) analyzed recordings of student talk during whole-class and small-group discussions. Students in the sample also completed standardized mathematics tests. The findings indicated that the students who more often developed their own ideas in conversation and explained their ideas to others achieved better results in those tests.

Sedova et al. (2019) carried out a survey on a sample of 639 ninth-grade students. They observed classroom talk in language arts lessons and recorded talk time and the number of utterances with reasoning for each student. Achievement was measured using a standardized reading literacy test. The analysis showed a link between how long a particular student spoke and how many utterances with argument that student contributed with the student's individual test results. This indicated that it is advantageous for student learning if the student actively speaks and argues.

Larrain et al. (2019) observed 187 students (aged 10 to 11) from eight classrooms during whole-class discussions and group-peer discussions in science lessons. Students were divided into an intervention and a control group. In the intervention group, instructions were supportive of student argumentation; in the control group, traditional (meaning more directive and teacher-centered) teaching methods were applied. The researchers recorded the number of argumentative utterances that each student formulated and heard. Student learning was assessed individually using both immediate and delayed post-test measures of

science content knowledge. The analysis showed that the formulation of counter-arguments predicted delayed gains in the intervention group only. The frequency of counter-arguments heard by students did not make a difference.

The research studies cited above differ in what types of student talk were recorded. Regardless of the differences in methodology, however, they all indicate that individual participation in classroom talk matters.

On the other hand, there have been some contrasting findings. Inagaki et al. (1998) examined a sample of 298 fourth-grade and fifth-grade students solving a mathematics problem in the classroom. They were involved in a whole-class discussion about alternative solution strategies and their verbal participation was observed. They then completed a post-test containing initial problem and transfer tasks. There was no statistically significant difference between the vocal students who contributed to the discussion and the students who did not.

A similar study was conducted by O'Connor et al. (2017). They used an experimental design on a sample of 44 sixth-grade students who had been involved in an intervention on using academically productive talk. For each student, the researchers counted the number of words spoken during a lesson. The researchers measured student learning gains using mathematics tests. No link was proven between the quantity of student verbal engagement in the lesson and student test scores. Both silent and vocal students performed equally well.

The results of these two studies indicated that under certain circumstances silent and vocal students can be equally successful. The authors identified the internal engagement of all students in the class as a decisive factor. Inagaki et al. (1998) claimed that Japanese sociocultural norms ensured that all students carefully listened during discussions and were thus able to utilize the discussion for learning even when they did not personally take the floor. Similarly, O'Connor et al. (2017) interpreted their findings as the consequence of students' long-standing enculturation in classroom norms of active listening.

Could it be OK to stay silent?

Nowadays, the role of student talk is highly valued in instructional science. However, alternative perspectives exist. Jaworski and Sachdev (1998) emphasized the positive impact of silence in the classroom, as it offers room for undisturbed thinking. Schultz (2010) noted that students who think quickly and formulate their ideas into articulate responses are often acknowledged by the teacher, but their speed does not necessarily mean that they think more productively than their silent peers. Thus, according to Ollin (2008) the notion of classroom participation should be revised to encompass silent thinking as something different from passivity.

O'Connor et al. (2017) claimed that silent students may be both engaged and disengaged. Those who closely follow the discussion with interest, but do not make verbal contributions, are silently participating according to these authors. Shi and Tan (2020) raised a similar point when hypothesizing the existence of different student learning patterns, some of which include vocal participation (asking questions, responding to questions, reading aloud, and interacting with the class) and others of which include silent participation (making eye contact, taking notes, nodding heads, reading in silence, and turning heads to follow the speaker). Goldin et al. (2019) identified three kinds of student learning practices central to participation in class: listening, speaking publicly, and making and using records. Again, classroom talk is situated alongside silent forms of behavioral engagement. This perspective

implies that it could be appropriate not to participate in classroom talk if the students stay engaged in another way.

In light of these ideas, we have to consider the diverse findings of the studies cited in the previous section. Could it be that silent students were attentively listening and staying focused in the studies by Inagaki et al. (1998) and d Connor et al. (2017), but not in the studies by Webb et al. (2014), Ing et al. (2015), Sedova et al. (2019), and Larrain et al. (2019)? We cannot infer this, as engagement was not examined in these studies. Therefore, it was necessary to include both student talk and student engagement in our analysis. This enabled us to consider whether classroom talk is a determinative predictor of student achievement itself or if it is just one particular way of expressing behavioral engagement that could be easily replaced by silent participation.

The present study

The aim of this study is to contribute to the understanding of the relationship between student classroom talk (vocal participation), internal behavioral engagement (silent participation), and achievement. We observed ninth-grade students in Czech language and language arts lessons, measuring the duration of classroom talk for each student. The students completed an engagement inventory to determine their behavioral engagement. Moreover, we measured student achievement using standardized reading literacy tests.

Although engagement is conceived as a meta-concept that includes four dimensions (behavioral, cognitive, emotional, and social), we decided to focus solely on behavioral engagement in this study. We do so because we consider internal behavioral engagement and student talk to be two aspects of one phenomenon – student participation (silent and vocal).[1]

To capture the complex interplay between student talk and internal behavioral engagement, we adopted a person-oriented approach that allowed us to identify profiles of students as characterized by unique patterns of talk and engagement. Our aim was to explore the patterns of configuration of talk and other components of behavioral engagement in students. We expected to find students who were talkative and engaged at the same time, but also students who were silent and engaged and students who were talkative and not engaged. Our aim was to identify distinctive student profiles and then link them to student achievement. For example, students who self-report high levels of engagement while demonstrating low talk participation may be learners who are excited to engage in the learning tasks but at the same time are too shy to speak in class. We wanted to compare such students with other configurations in terms of student achievement.

We asked the following research questions:

1. What kinds of patterns concerning student talk and internal behavioral engagement can be identified?

[1] We addressed other forms of engagement (cognitive, emotional, and social) in a previously published study (Sedlacek & Sedova 2020). In that study, we confirmed that individual forms of engagement are linked to student talk in different ways. For example, cognitive engagement increases participation in classroom talk, but social engagement decreases it. Therefore, we consider it useful to work with the individual forms of engagement separately.

2. How do different patterns of student talk and internal behavioral engagement contribute to student achievement?

Method

The research design was developed in cooperation between the authors of this study and the Czech School Inspectorate (CSI). The CSI is a key central body tasked with evaluating and regulating the Czech educational system. It distributes and assesses standardized tests focused on different areas of learning to measure student achievement. In October 2017, the CSI conducted selective reading literacy testing among ninth-grade students. At our request, the CSI distributed the engagement inventory together with their literacy tests. At the same time, we conducted observations in Czech language and language arts classes to measure individual student participation in classroom talk. Given that the dependence of student achievement in Czech schools on socioeconomic status is evident from international surveys (Blažek & Příhodová, 2017), we used the occupational status of the families as the control variable in our analyses.

Sample

The sample for this study consisted of ninth-grade students attending lower secondary school (ISCED 2 A) who were involved in the CSI reading literary testing, a national sample survey covering 163 schools from a total of 4,221 Czech lower secondary schools. From this sample, the researchers chose schools from three Czech municipalities. In total, 23 schools were approached, of which two schools refused to take part in the research. Twenty-one schools and 32 classes (all ninth-grade classes) were included in the study. The sample consisted of 639 students; 52% were boys and 48% girls. The student ages ranged between 14 and 15 years.

In all of these classes, researchers conducted observations using a tablet application for measuring classroom talk in two different Czech language and language arts lessons (2×45 min). In total, we recorded data from 64 lessons.

Measures

Student achievement

We used the results of individual students on reading literacy tests designed and evaluated by the CSI as an indicator of student achievement. In Czech curricula, developing reading literacy is mostly concentrated in the Czech language and language arts, which is the subject where we carried out the observations. Testing took place in November 2017. The test consisted of 16 tasks. An example of one of the tasks is attached in Appendix 2. Students were given several longer extracts from texts written in Czech. Their level of understanding was assessed with several open and closed-ended questions. The tasks covered all areas of reading literacy that were operationalized in accordance with the curriculum for the grades concerned. In this study, we used the student success rate on the main section of the test (100% is a perfect score) as the indication of student achievement.

Table 1 Results of the Confirmatory Factor Analysis

Variable	Examples of items	No of items	C. α
Behavioral engagement	I put effort into learning.	8	0.71
Model Fit Test Statistic / *df* / (*p*)	652.173 / 659 (0.00)		
RMSE	0.042		
CFI	0.900		
TLI	0.893		
SRMR	0.098		

Note: RMSE: root mean square error, CFI: comparative fit index, TLI: Tucker-Lewis Index, SRMR: standardized root mean square residual

Student participation in classroom talk

We operationalized the student participation in classroom talk as the talk time – the amount of time a student talked during a lesson. In each class, we observed two lessons. Teachers were instructed to teach as they normally would. We therefore assume that both teachers and students behaved in a way similar to their usual conduct. We only recorded talk that was part of whole-class discussions and that involved interactions between the teacher and students and among the students themselves. We excluded types of talk such as reading a text, individual work, and group work. We also excluded any communication that did not relate to the subject matter at hand, such as organizational matters.

The talk time was recorded using a tablet application developed by the study authors. The application is based on a class diagram with places marked where each student sits. The observer who recorded talk time was present in the classroom. The moment a student began to speak, the observer marked the student's place on the diagram and activated the timer. When the student finished, the observer stopped the timer. Observations took place in November and December 2017. Only those students who attended both lessons were included in the analysis. For each student, we considered their average talk time for the two lessons.

Student behavioral engagement

We applied the engagement inventory of Fredricks et al. (2016) measuring four dimensions of student engagement: behavioral, emotional, cognitive, and social. In relation to the research questions, we only considered the scale of behavioral engagement in this study.

In adapting the engagement inventory for the Czech language, we followed principles of cross-cultural adaptation of self-reported measures (Beaton et al., 2000) using back translation and a monolingual test in the target language. Questionnaire items were dichotomous (Yes=the statement applies to me / No=the statement does not apply to me).

Given the different context of use, we conducted a thorough psychometric analysis of the scales. In the original version of the questionnaire, behavioral engagement comprised 11 items (see Fredricks et al., 2016). In our version, we used confirmatory factor analysis (CFA) to test the dimensionality of the scales and the association of individual items with latent factors (the dimension of engagement). Given the dichotomous nature of the questionnaire items representing manifest variables, the weighted least square mean and variance adjusted (WLSMV) method of estimation was employed (Li, 2016). The model is presented in more detail in Table 1.

The results of the confirmatory factor analysis (CFA) outlined in Table 1 confirmed the consistency of the engagement scales. The model proved to be a good fit to the data. This was confirmed by the parameters of the model, which largely conformed with the boundaries indicated in the literature (Kline, 2005; Hu & Bentler, 1999): root mean square error of approximation (RMSEA)=0.042, comparative fit index (CFI)=0.901, Tucker-Lewis Index (TLI)=0.893, and standardized root mean square residual (SRMR)=0.018. In this perspective, only the significance of chi-squared (χ^2) was not in conformity with the parameters required. However, this was due to the sample size rather than a substantial discrepancy between the model and the data. Based on these results, indices for individual dimensions of student engagement were calculated. As mentioned above, in this text we use only the subscale of behavioral engagement. This index was produced as a sum of positive answers to the items; the higher the value of the aggregate index, the higher the behavioral engagement of the individual student. Table 1 indicates that we removed from the indices items with weak loading of the resulting latent factor. All the items used to develop the indices are listed in Appendix 1.

Student socioeconomic background

Since student socio economic background has been repeatedly examined as a predictor of student engagement or student achievement, we applied these variables into our models (see Bodovski et al., 2017; Fredricks et al., 2018; Jurik et al., 2013; Pfeffer, 2008, Tapola et al., 2013).

Student socioeconomic background was measured using the index of the highest occupational status of their parents (HISEI). The International Socio-Economic Index of Occupational Status (ISEI) represents a one-dimensional measurement of social status as an occupational status. Information on the occupations of students' parents was collected through open-ended questions. The responses were coded using the four-digit International Standard Classification of Occupations codes and then recoded to the ISEI (Ganzeboom et al., 1992). Three indices were calculated based on this information: father's occupational status; mother's occupational status; and the highest occupational status of parents (HISEI), which corresponds to the higher ISEI score of either parent or to the only available parent's ISEI score. For all three indices, higher ISEI scores indicate higher levels of occupational status. The ISEI score is between 90 (*judge*) and 10 (*assistant cook*), and it reflects the average level of education and the average earnings, although it does not have a direct connection to income. The ISEI score is generally used as a valid explanatory variable because it is more strongly correlated with the status of the children.

Data analysis

We conducted a cluster analysis. The goal of our cluster analysis was to identify the smallest number of latent classes that adequately describe the associations among the observed variables (Nylund-Gibson & Masyn, 2016; Vermunt & Magidson, 2002). Regardless of the purpose of the research, the cluster method requires two steps. First, we have to determine the best or most natural number of groupings inherent in the data. Second, we perform the cluster analysis itself to assign each observation to its best-fit cluster. Due to the large number of observations, we decided to use a partitional cluster analysis. Hierarchical approaches

were not appropriate because the graph quickly became too unwieldy to interpret. K-mean, a partitional clustering method, has the advantage of being able to manage a massive number of cases, but it requires the assignment of clusters at the outset.

Next, the Pearson correlation analysis was performed to identify the relationships among all variables. Then, analysis of variance (ANOVA) and the chi-square test were used to evaluate profiles with other variables. Finally, pairwise comparisons were used as well as partial eta-squared to interpret meaningfulness. In this study, the SPSS (version 26.0) and R software was used for data analysis.

When creating the analytical strategy for this study, we also considered the aggregated data. Class-level behavioral engagement turned out to be an insignificant factor. Class-level talk time had little impact on achievement score. We presented these findings in another study (Sedova et al., 2019). We did not include it in the procedure in this study; the effect here was negligible, and the interpretation was rather unclear.

Research ethics

We first arranged to work with the CSI. The CSI agreed that we could use their data if the schools involved and the students' parents agreed. In the next step, we sought oral consent from the school principals and teachers to conduct the research in their schools and classrooms. We then sought written consent from all parents of the students participating in the observed classes. Participants were assured of confidentiality and of their ability to withdraw from the study at any time. No one withdrew during the study. All participants were assigned numbers, and all personally identifying information was removed from the dataset prior to processing.

Limitations of the study

There are some methodological limitations to be considered when discussing our findings.

Participation in classroom talk and internal behavioral engagement were measured only for Czech language and language arts. In these subjects, talk plays a naturally prominent role; it is the center of the curricula. Similar results might not be found in non-linguistic subjects.

In each class, we observed only two lessons. We believe that data from these two lessons represent the nature of classroom talk in the given class and the participation patterns of individual students. However, altered student behavior is possible, especially under the specific circumstances of observers in the classroom. Moreover, in this study we operationalized the student participation only in terms of the quantity of student talk (talk time), not in terms of the quality (e.g., incidence of reasoning or argument).

Finally, the procedure for identifying student profiles has limitations. When the k-means method is used, a problem usually arises regarding the decision on the number of profiles (clusters). This presupposes either a theoretical basis that defines the number, an estimation process, or some other statistical analysis. We used the "information criteria" (AIC and BIC). According to the data, we were not able to use the best solution because one profile was not sufficiently saturated with respondents. The five-profile model used in this respect also slightly distorts reality. The profiles are based on similarities in two variables that do

Table 2 Means, Standard Deviations, and Other Characteristics of Key Variables

Variable	N	M	SD	1	2	3	4
1. Reading literacy (success in %)	602	43.86	15.36	-	0.18**	0.06*	0.20**
2. Talk time (seconds per lesson)	533	12.19	13.88		-	0.09	0.11*
3. Internal behavioral engagement	638	5.01	2.21			-	0.06
4. HISEI	582	47.52	18.56				-

$p<0.05$ **$p<0.01$; M: mean; SD: standard deviation

not have the same scale, which is also a limitation on the estimate's accuracy. We tried to eliminate this by standardizing the variables.

Results

Descriptive statistics

Descriptive statistics are presented in Table 2. On average, students enrolled in our study had test scores of approximately 44% and their talk time in one lesson was approximately 12 s. The standard deviation shows high variability; there were significant differences in the intensity of participation among the students in the sample. This is also evidenced by the fact that 46 students in our sample spoke for 0 s. The average individual HISEI measured through the higher parent employment status was 45.88 (SD = 15.31). Therefore, the mean was nearly mid-range as the scale ranged from 16 to 90.

Table 2 shows that the correlations between the monitored variables verified through Pearson correlation analysis[2] were not very strong. Only two are worth noting. The correlation between student achievement and student socioeconomic background was more predictable[3] ($r=0.20$; $p<0.01$). The second strongest relationship was identified between student achievement and student talk time ($r=0.18$; $p<0.01$). Although these are not strong associations, they cannot be marginalized, because learning outcomes are undoubtedly a multifactor phenomenon. The strength of the relationship of one predictor is thus inherently limited. On the other hand, the correlation between talk time and internal behavioral engagement was weak (0.09), indicating that these two phenomena are separate – at least in Czech classrooms.

Cluster formation

Cluster analysis was used to identify the latent subgroups of students in our sample in terms of their share of classroom talk and the degree of their internal behavioral engagement. This meant, firstly, determining the number of clusters.[4] Many methods can determine the appropriate number of clusters, but there is little consensus as to which is the most efficient or accurate (Saenz et al., 2011). Given the nature of both variables' measurement, we

[2] We used a partial correlation coefficient, meaning that we eliminated the influence of other variables.

[3] The effect of student socioeconomic background in our sample corresponds to the results of international surveys (Blažek & Příhodová, 2017).

[4] This is an assumption of k-means cluster analysis.

Table 3 Information Criterion for the Cluster Solution; Number of Students for Each Cluster

Number of cluster	AIC	BIC	n1	n2	n3	n4	n5	n6	n7
1	745,894	763,009	528						
2	518,254	552,482	47	486					
3	372,762	424,105	39	171	323				
4	298,882	367,338	11	168	49	305			
5	234,115	319,685	18	45	150	216	99		
6	204,443	307,128	70	80	76	157	125	2	
7	192,718	312,516	18	1	45	150	4	216	99

decided to use the popular Akaike information criterion (AIC) and the Bayesian information criterion (BIC). In doing so, we adhered to the basic rule that the solution (the number of clusters) with the lowest information criteria is the most appropriate for the data. The SPSS two-step clustering component includes the option to calculate the AIC or BIC for a range of possibilities and then automatically estimate the number of clusters in a dataset. Because the variables were measured with different scales, it was crucial to first standardize all the variables before the k-means cluster analysis. We summarize the results in Table 3.

The values of the information criteria vary. The solution of seven clusters best corresponds with the data according to the AIC score; the BIC score indicated six clusters. We favored the solution according to the AIC values, as some studies indicated that it was more appropriate for our estimates (e.g., Vrieze, 2012). However, in both the six-cluster and seven-cluster solutions, the smallest group had fewer than four members, which would have prevented subsequent statistical analysis. For this practical reason, a five-cluster solution was determined to provide the most optimal fit with the data.

We identified the following profiles:[5] *(1) eager*: students who talk a lot and report being highly engaged ($n=18$; 9 girls); *(2) chatty*: students who talk a lot but report low engagement ($n=45$; 23 girls); *(3) diligent*: students with slightly below average talk time and high reported engagement ($n=150$; 87 girls); *(4) aloof*: students with low talk time and below average reported engagement ($n=216$; 99 girls); and *(5) disconnected*: silent students who report a low level of engagement students ($n=97$; 35 girls).

This five-cluster model was validated with analysis of variance (ANOVAs), which showed that the groups differed in the criterion variables on which the cluster analysis was based (Table 4). For both variables, with one exception, a statistically significant difference between all profile groups was confirmed. There was no difference between *aloof* and *disconnected* in talk time. Similarly, no significant difference was confirmed between *eager* and *diligent* in behavioral engagement.

We examined the extent to which the identified profile groups differed in gender and socioeconomic status. The results of cross tabulation and the chi-square test indicated that gender was unevenly distributed among the profile groups (χ^2 (df 4)$=12.14$, $p=0.02$). The findings suggested that the proportion of boys was higher than expected among *disconnected* students (adjusted standardized residual$=2.6$), and the proportion of girls was higher than expected in the *diligent* students (adjusted standardized residual$=2.9$).

[5] The total number of students included in the profiles of the selected model is 526. The discrepancy with the sample size (639) is because only students who passed all measurements were included in the cluster analysis (533). Furthermore, several students did not fit into any of the identified profiles.

Table 4 Mean Differences in Talk Time and Behavioral Engagement for All Profiles, ANOVA.

Variable	1. Eager Mean (SD)	2. Chatty Mean (SD)	3. Diligent Mean (SD)	4. Aloof Mean (SD)	5. Disconnected Mean (SD)	ANOVA F	Pairwise comparison
Talk time	118.32 (29.75)	62.99 (24.04)	19.56 (17.81)	9.02 (8.90)	10.12 (10.01)	333.49***	1>2,3,4,5 2>3,4,5 3>4,5
Behavioral engagement	6.73 (1.12)	3.84 (1.39)	7.30 (0.73)	5.21 (0.81)	1.41 (0.94)	615.26***	1>2,3,4 2<1,3,4 / 2>5 3>2,4,5 4<1,3 / 4>2,5 5<1,2,3,4

Note. Pairwise comparisons reported between groups in which differences are statistically significant at $p<0.05$ with ANOVA post hoc Bonferroni

*** $p<0.001$

Table 5 Mean Differences in Socioeconomic Status for All Profiles, ANOVA.

	Eager Mean (SD)	Chatty Mean (SD)	Diligent Mean (SD)	Aloof Mean (SD)	Disconnected Mean (SD)	ANOVA F	Pairwise comparison
HISEI	49.65 (16.68)	42.3 (15.04)	45.53 (16.41)	47.31 (15.01)	42.16 (14.33)	2.21 $p=0.07$	

Table 6 Mean Differences in Reading Literacy for All Profiles, ANOVA.

Variable	Eager Mean (SD)	Chatty Mean (SD)	Diligent Mean (SD)	Aloof Mean (SD)	Disconnected Mean (SD)	ANOVA F	Pairwise comparison
Reading literacy (success in %)	53.08 (13.99)	46.10 (15.31)	43.46 (15.23)	44.48 (15.88)	41.16 (14.51)	2.47*	1>5

Pairwise comparisons reported between groups in which differences are statistically significant at $p<0.05$ with ANOVA post hoc Bonferroni

* $p<0.05$

When it comes to socio economic status (HISEI), one-way ANOVA showed no statistical significance between the latent subgroups. Differences naturally exist; the highest average socioeconomic status was measured among *eager* students. The *disconnected* group had the lowest average score. The values for all profiles are given in Table 5.

Comparison of latent profile groups with respect to student achievement

Finally, an analysis was conducted to determine the extent to which the identified profiles differed in student achievement. The ANOVA and pairwise comparison results suggested that students in the five identified profile groups differed in their reading literacy tests (Table 6). However, there was only a significant difference between *eager* and *disconnected*.

The trend seems to be in agreement with the assumption that higher levels of participation in classroom talk and behavioral engagement mean better achievement in the reading literacy test. This is evidenced by the fact that students in the *eager* cluster, characterized by both high talk time and high internal behavioral engagement, were the most successful in the tests. Moreover, *disconnected* students, who had the lowest talk time as well as the lowest engagement, performed worst in the tests.

The differences between other profiles are not significant. However, we must consider that *chatty* students, who did well in terms of quantity of classroom talk but not in terms of their internal engagement, were the second most successful in the reading literacy tests. Moreover, the *chatty* students were aligned with the second lowest HISEI in our sample. It is noteworthy that the *chatty* profile is somewhat similar to the *disconnected* profile in terms of HISEI and engagement. The only big difference is in talk time, which could imply that the high achievement scores of *chatty* students are due to the sizable participation of these students in classroom talk.

We also noted the fourth position of the *diligent* students. This indicates that internal behavioral engagement unaccompanied by talk does not guarantee high student achievement.

Discussion

This paper is based on studies emphasizing the importance of engagement in student achievement (e.g., Fredricks et al., 2004; Chang et al., 2016; Wang & Degol, 2014; Wang & Eccles, 2012), especially in its behavioral component (Bae & DeBusk-Lane, 2019). We explored how participation in classroom talk and internal behavioral engagement are combined in students. To our knowledge, this is the first such study. A study by Schnitzler et al. (2020) measured observable student participation operationalized through student hand-raising. They combined this external form of behavioral engagement with self-reported cognitive and emotional engagement. Our study is unique due to its focus solely on behavioral engagement. Utilizing both measurements of talk time and of self-reported data on internal behavioral engagement allows us to enter the discussion on silent and vocal forms of student classroom participation (O'Connor et al., 2017; Shi & Tan, 2020).

Our first research question sought patterns in student talk and engagement. We found five distinct profiles: *eager* (3%), *chatty* (9%), *diligent* (29%), *aloof* (41%), and *disconnected* (18%). In terms of prevalence, the profiles with a low talk component (*aloof*, *diligent*, and *disconnected*) proved to be much more common than the profiles with a high talk component (*eager* and *chatty*). This corresponds to the fact that teaching in Czech schools is still traditional and not student-oriented, manifesting as a limited allowance of student talk during class (Sedova et al., 2014). The most frequent profile was rather low in internal engagement (*aloof*), but the second was distinguished by high internal engagement (*diligent*). The dominance of these two profiles could be explained in relation to the social dynamics of the class and cultural norms. As argued by Ulmanen et al. (2016), adolescent students feel tension between enjoying learning and belonging to a peer group in the class. *Aloof* students are those who adhere more to the peer norms of the adolescent group, as Czech ninth-grade students do not tend to esteem their peers who talk a lot with the teacher (Sedlacek & Sedova 2020). *Diligent* students adhere more to the cultural norms of Czech schools as Czech teachers appreciate attentive and unobtrusive students (Sedova et al., 2012).

Our results are in line with those of Schnitzler et al. (2020), who found the *disengaged* profile (low in hand-raising and in cognitive and emotional engagement) to be prevalent in the German eighth grade, and the *busy* profile (extremely high in hand-raising, high in cognitive and emotional engagement) to be the rarest. Students who participate frequently and are internally engaged are a minority at lower secondary schools.

From the five profiles we identified, three were consistent in both components, which means vocal and silent participation were equally developed, either both high (*eager*), or both low (*aloof*, *disconnected*). Two profiles were inconsistent – *chatty* with high vocal and low silent participation, and *diligent* with low vocal and high silent participation. The results of previous studies (Bae & DeBusk-Lane, 2019; Conner & Pope, 2013; Schnitzler et al., 2020) have indicated that student engagement patterns can be inconsistent across the behavioral, cognitive, and emotional components. Our study indicates that they can be inconsistent even within the behavioral dimension. This shows how complex and complicated student engagement patterns are. The inconsistent profiles should be of interest as they indicate tension between vocal and silent forms of participation. *Diligent* students were the most frequent profile with high internal engagement. This indicates that many Czech students who are internally engaged nevertheless prefer to stay silent. *Chatty* students were the more frequent of the two profiles with high talk. This indicates that those Czech students who talk a lot during a lesson are rather disengaged.

The second research question asked how talk and behavioral engagement related to student achievement. Not surprisingly, we found *eager* students to perform best and *disconnected* ones to perform worst in literacy tests. This is in line with previous findings that suggest that engagement of any form increases achievement and students are seriously disadvantaged if no engagement forms are present (Bae & DeBusk-Lane, 2019; Jansen et al., 2016; Schnitzler et al., 2020; Wang & Peck, 2013).

Although the difference between *eager* and *disconnected* was the only statistically significant finding in our sample, the performance rankings of the other profiles are worth noting. The second position was *chatty*, the third was *aloof*, and *diligent* took fourth place.

The weak position of *diligent* is unexpected in light of literature emphasizing the positive impact of engagement on student achievement (see Fredricks et al., 2004; Chang et al., 2016; Wang & Degol, 2014; Wang & Eccles, 2012). Our analysis may indicate that internal behavioral engagement does not sufficiently guarantee good school performance. By contrast, the favorable placement of internally unengaged *chatty* students is surprising, especially when considering their low socioeconomic status. The only observed distinction between well achieving *chatty* and poorly achieving *disconnected* students was the quantity of student classroom talk.

Individual student talk matters (see Ing et al., 2015; Larrain et al., 2019; Sedova et al., 2019; Webb et al., 2014), and vocal participation contributes more than silent participation. According to our data, various engagement forms cannot be considered as interchangeable.

Our findings have obvious practical implications. Teachers should invite all students to participate in classroom conversations as the inequalities in student talk can create uneven learning opportunities for different students in the same class (Sedova et al., 2019). Teachers should not assume that silent but attentive and engaged students benefit from classroom discourse in the same way as their more vocal peers. The fact that students who are silent and disengaged are at risk is well known (see Bae & DeBusk-Lane, 2019; Schnitzler et al., 2020). Our study also identifies students who are internally behaviorally engaged but stay

silent as being at risk. We can hypothesize that these students do not talk due to their introversion and shyness (Caspi et al., 2006). The task for the teacher is to help these students to raise their voices and thus improve their learning opportunities. This is to be especially highlighted in the context of Czech school cultural norms that expect students to be attentive but not necessarily vocal. To enable all students to enhance their learning, these norms have to be overcome.

Appendix 1. Behavioral engagement

1. I stay focused.
2. I answer questions in class.
3. I put effort into learning.
4. I keep trying even if something is hard.
5. I ask questions in class.
6. I complete my homework on time.
7. I talk about Czech language and language arts outside of class.
8. I try to learn more about the topics we cover in class.
9. I don't participate in class (Reverse coded).
10. I do other things when I am supposed to be paying attention (Reverse coded).
11. If I don't understand, I give up right away (Reverse coded).

Appendix 2. An example of one of the tasks from the reading literacy test

Read the text and choose the right answer.

Towards the end of the 19th century, the disease known as beriberi (from the Sinhalese "I cannot") with characteristic symptoms ranging from weakness to paralysis spread dramatically in the Dutch East Indies (present-day Indonesia). The Dutch government, concerned that there was hardly anybody left to work on the plantations, set up a special committee. Christiaan Eijkman (1858–1930), a physician of the state prison in Batavia (present-day Jakarta) was among its members. One beautiful day, Dr. Eijkman was enjoying a view out of the window of his official apartment overlooking the prison courtyard. His head full of the cursed beriberi, he was watching the hens pecking around the yard. He was intrigued by their strange movements and postures; somehow they reminded him of the sick inmates… It turned out that the hens were, through kitchen garbage, eating basically the same diet as the inmates—mostly rice. Specifically, it was polished rice. The husks had been removed because a product that had been processed in this way looked better and as a result could be priced higher.

The already suspicious Eijkman only needed to ask the "competitors" a few questions and everything was clear. Jails where the inmates consumed only polished rice had high

numbers of beriberi patients, while in the jails where the managers economized and fed their inmates with cheap rice that still had the husks, the disease was quite rare.

In 1897, Eijkman published his discovery. Despite its significance, there was almost no response. At that time, nutrition science was dominated by the caloric assessment of nutrients, while the causes of diseases were decided by young and ambitious bacteriology. The idea that a mere deficiency in some trace element in the diet could cause a serious disease or even death simply seemed ridiculous.

However, in 1911 Eijkman's work was discovered by a young biochemist of Polish origin, Casimir Funk (1884–1967), who was living in London. He first tested Eijkman's conclusions on pigeons and then got a kilo of rice husks and used them to laboriously prepare six grams of white powder. This powder, even in milligram amount, reliably cured beriberi. Funk called it vitamin B; *vita* means "life" in Latin and *amin* was for the amin group that the powder contained. He used letter "B" to avoid confusion with a substance of a similar category that had been recently discovered in milk by Funk's colleague Frederick Hopkins (1861–1947) who called it growth factor A (today known as vitamin A). It is evident that Funk's name was widely accepted, even though the amin group after which it was named is out of all the thirteen vitamins that are known contained only in "his" vitamin (it is at present known as vitamin B_1). Eijkman and Hopkins were awarded the Nobel Prize in 1929.

(Houdek F., Tůma J.: Objevy a vynálezy tisíciletí [Discoveries and Inventions of the Millennium], Nakladatelství Lidové noviny 2002, p. 233)

Which of the following statements is directly contradicted in the text above?

○	Christiaan Eijkman died in prison in Batavia.
○	The beriberi disease can be cured with six grams of a special white powder.
○	Casimir Funk was later awarded the Nobel Prize.
○	The beriberi disease was widespread in all prisons of the Dutch East Indies.
○	Vitamin B1 can be found in particular in polished rice; rice that still has the husks does not contain it at all.

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Declarations

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