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Impact of flexible seating on the quality of teacher-student interactions with coping to stress adaptation and mental health of elementary students in Quebec

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ABSTRACT

To meet the requirements of the 21st century school, it would therefore seem necessary to rethink how mental health is organized and particularly within the physical learning environment. This has been done in Quebec, Canada, where 'flexible' seating allow students to choose where they sit and work during the day. Student-student and student-teacher exchanges also have an impact on the mental health of children in school. Indicators of mental health were studied among 107 students in three flexible seating group and three fixed seating group. Two models were created based on gender, and Student T-tests were used for two databases. Another database for teachers was analyzed descriptively by group. Girls in the flexible seating group had lower scores for internalizing problems, inattention/hyperactivity, school problems, and emotional symptoms compared to girls in the fixed seating group. For boys, there was a decrease in school problems alone and an increase in the other variables. For teachers, there was an upward trend in median scores in the flexible seating group. In general, classroom layout appears to have played a role in the students' school mental health and a particularly beneficial role for girls. In practice teachers should consider that some of their students may not feel comfortable in a flexible layout. More support and help from the teacher to these students could help them to cope with the changes brought by flexible seating. Beyond the students' comfort, for teachers, this would allow them to meet their students' needs through differentiated instruction and differentiated learning.

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Flexible seating; school mental health; stress coping; heart rate variability; quality of interactions

Introduction

In 1946, the World Health Organization (WHO) defined health as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. Mental health is seen as an integral part of health and well-being. This vision of health proposed by WHO is particularly evident in their 2012 action plan for mental health for the 2013–2020 period (WHO World Health Organization 2013). In 2019, WHO reported that 16 % of health problems

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globally among 10–19-year-olds were due to mental health disorders (WHO 2019). In 2018, the Institut de la statistique du Québec (ISQ) also reported an 8% increase (21 % to 29 %) since 2011 in mental health disorders among high school youth (Julien 2018). A significant mental health risk factor is exposure to frequent or prolonged stressors (Lupien et al. 2009; Herts, McLaughlin, and Hatzenbuehler 2012), which the school environment can increase. Thus, school has a central role in students' overall life and development since they will spend the majority of their time there (Konu and Rimpala 2002; Baudoin and Galand 2018). The work of Corral-Verdugo and Frías-Armenta (2016) suggests that a positive environment can have an effect on well-being by improving the quality of the school environment, allowing for better management of stressors influencing student functioning. Indeed, good school mental health is characterized by low levels of stress, a sense of psychological well-being and, ultimately, good adaptive and behavioral functioning among students.

In Quebec, as a result of the *Lab-École* project (<https://www.lab-ecole.com>) implemented by the Ministry of Education and Post-Secondary Studies, so-called flexible seating are gaining ground. Flexible seating, as opposed to fixed/traditional seating, have a more student-friendly and open layout, focusing on comfort and seating choice. Students have the opportunity both to choose various seating options (chairs, ottomans, exercise balls, cushions, and so on) and to choose their workspaces (round tables, single tables, high tables, and so on) (Havig 2017). This type of physical arrangement in classrooms has been the subject of a few studies, but no comparative studies regarding students' mental health have been conducted in Quebec. Studies reviewed show that elements such as natural light, color of walls and supplies, and space, have a positive influence on student learning and concentration (Barrett et al. 2012; Dornhecker et al. 2015; Barrett et al. 2017; Havig 2017). Likewise, flexible seating classrooms let students move throughout the day. Movements, whether performed by one of the seats or just the change of workspace, allow students to maintain concentration (Savina et al. 2016; Havig 2017; Attai et al. 2020) and increase mobility which is beneficial for the body and muscles to avoid bad posture, static positions, etc. (Anderson and Hartley 2019). Indeed, these various parameters seem to make students more focused, more independent, and less stressed. A reduction in behavioral problems has also been noted (Barrett et al. 2017; Havig 2017). Protective factors that positively influence student mental health and decrease exposure to stressors include the quality of the school environment, classroom design and interactions (Amoly et al. 2014), and caring relationships and social support provided by teachers (Heaney and Israel 2008; Kruger, Reischl, and Gee 2007). In addition, based on a review of the literature, few studies have explored the links between flexible seating on student-teacher interactions (e.g. Kariippanon et al. 2018, 2019), especially in elementary schools. Interactions, however, are an important component to consider in reducing stress at school (Baudoin and Galand 2018). The quality of interplay between student and teacher has a fundamental role in student engagement (motivation, interest, attention, etc.) which impacts academic success and well-being (MÉES, 2017). Thus, a teacher who will demonstrate a greater social support will positively participate in a good school and relational climate leading to a better well-being for students (Baudoin and Galand 2018).

Study objectives

In that context, the question is: What is the role of classroom layout on the quality of interaction inside the classroom and on the school mental health of elementary students in Quebec? The present study relies on three objectives: first, compare the quality of interaction between student and teacher. Second, compare the mental health indicators' scores between two groups (flexible seating and fixed seating), and third, compare these indicators by gender.

Theoretical framework

One of the challenges for the teacher is to identify how each student learns since learning is a complex process, often involving a combination of different strategies (Hattie 2017). The theoretical model of the *Teaching Through Interactions* (TTI) suggests that learning space layout and the teacher have an influence on student behavior and engagement to learn (Hamre and Pianta 2006; Hamre et al. 2008), as illustrated in Figure 1.

The school learning space concerns all aspects of daily experience, including the layout of physical space and the social interactions that take place, and influences the overall development of students, including mental health (Huynh et al. 2013). In recent decades, publications on the school environment (Clément 2019; CSÉ 2020; MÉES, 2017) have been a decisive step in considering the role of the physical layout and organization in the overall development of children and their mental health at school.

Consequently, studies interested in the effects of the physical layout at school have been able to identify certain parameters of the architectural feature (e.g. natural light, space, acoustic quality, air quality) having positive effects on various indicators of student learning, success and persistence, mental health and well-being (Allaire 2013; Barrett et al. 2017; Cheryan et al. 2014; Hébert and Dugas 2019). Other studies have shown that the aesthetics, safety and cleanliness of school spaces positively influence academic performance, sense of belonging, practices aimed at meeting students' needs and their mental health (Cheryan et al. 2014; Joing et al. 2018; Vallot 2010). Their studies suggest that flexible seating in classrooms created a space where teachers could give instructions and where students could participate in independent work, group work and movement while learning. These new types of spaces in the classroom would allow students to take control of their learning needs (Burgeson 2017; Tafahomi 2021).

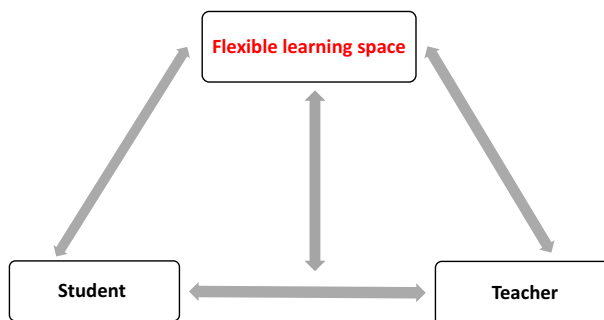


Figure 1. Adaptation from Hamre and Pianta (2006).

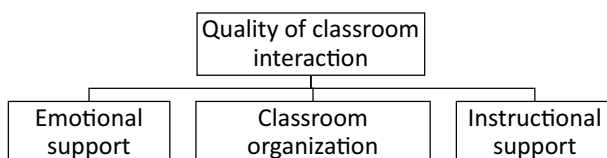


Figure 2. CLASS model (Pianta, LaParo, and Hamre 2008).

Design of the learning space can therefore affect students' social interactions and cognitive and social-emotional development (Broto 2013; Huynh et al. 2013). In addition, as shown in Figure 2, the TTI model provides a tool for observing the quality of classroom interactions based on three areas: emotional support, classroom organization, and instructional support.

Emotional support refers to the teacher's sensitivity and responsiveness to students. This support relates to the teacher's behaviors that help the child develop positive peer relationships, develop an interest in learning, and feel comfortable in the classroom. Classroom organization refers to the way the teacher sets up and manages the classroom. This is reflected in classroom management that allows students to optimize their engagement time, regulate their behavior, and maintain their interest in learning situations (Pianta, LaParo, and Hamre 2008). Finally, instructional support refers to instructional strategies that are based on student needs and foster their ability to find strategies on their own (Curby, Rimm-Kaufman, and Abry 2013).

Methodology

Research design

The study was approved by the Institutional Human Research Ethics Committee (CIEREH) of the Université du Québec à Montréal (UQAM) in October 2019.

As we explored the effect of flexible classroom seating on the school mental health of students and the quality of student-teacher interaction, a quasi-experimental design with a comparison group has been used. This method allows us to estimate the effect of an intervention in the context of education, as we couldn't control the composition of groups (Reichardt 2009).

A multi-method approach including self-reported, observational, and psychophysiological measures was used.

Measuring instruments

Quality of classroom interactions was measured using the Classroom Assessment Scoring System (CLASS), and the SwivlTM video recorder to collect observational data. Mental health was measured using the BASC-3 self-reported questionnaire on student school and behavioral adaptive functioning. Finally, stress was measured using a physiological marker of stress adaptation, namely, nocturnal heart rate variability (nHRV).

Quality of Classroom Interactions (CLASS) (Pianta, LaParo, and Hamre 2008)

This is a behavioral observation tool (students and teachers) to determine the quality of classroom interactions based on three dimensions: emotional support ($\alpha = 0.83$); classroom organization ($\alpha = 0.97$); instructional support ($\alpha = 0.82$).

Student school and behavioral adaptive functioning (BASC-3) (Reynolds and Kamphaus 2015)

This is a standardized self-report questionnaire on student behavioral, emotional, social, and school functioning. Component scales ($\alpha = 0.89$ – 0.95) are inattention/hyperactivity, internalizing problems, school problems and emotional symptoms.

Psychophysiological measurement of stress

Student stress was measured using nocturnal heart rate variability (nHRV), which is a dependent marker of an individual's diurnal stress state (Iverson, Stampfer, and Gaetz 2002). nHRV is the variation in time between heartbeats and is regulated by the central nervous system; it provides a measure of an individual's adaptation to stress (Marsac 2013) and reflects the individual's capacity for emotional regulation (Servant et al. 2008, 2008). nHRV was measured using Hexoskin® biometric vests. Each student wore a Hexoskin® vest for two consecutive nights. Biometric properties were validated and were equivalent to those obtained in the laboratory using standard devices (Villar, Beltrame, and Hughson 2015).

Statistical society

The study sample, which was a convenience sample, consisted of 107 students in grades 5 and 6 (10 to 13 years old) in the Greater Montreal area. They were drawn from three classes with flexible seating ($n = 56$, experimental group) and three classes with fixed seating ($n = 51$, control group). The average age was 11.18 years old.

The participant schools were in rural and semi-rural areas. The socioeconomic status (SES) of these schools, which is a control variable, was assessed. The three fixed classrooms were part of the least advantage schools. Meanwhile, two of the flexible classrooms were in the most advantage schools (the remaining one was ranked like our fixed classrooms). The Disadvantaged Index for all public elementary and secondary schools, made available by the Ministry of Education and Post-Secondary Studies, provided a picture of the socio-economic background index (IMSE) for each school in our sample (see Table 1). Schools are ranked on a scale from 1 to 10, with a score of 1 representing the least disadvantaged schools and a score of 10 representing the most disadvantaged schools (MÉES 2020).

Table 1. Socio-economic environment index (IMSE) and decile rank for each school in the sample.

Classroom	Grade	School	Socio-economic environment index (IMSE)	Decile rank (IMSE)
Fixed seating group				
Classroom 1	5	School 1	9.52	7
Classroom 2	5	School 1	9.52	7
Classroom 3	6	School 2	9.15	6
Flexible seating group				
Classroom 4	5	School 3	3.79	2
Classroom 5	5	School 4	5.50	3
Classroom 6	6	School 5	8.77	6

Statistical analyses

Statistical analyses were performed on the entire sample using STATA 15.1 software, with a significance level less than or equal to 0.05. For data related to indicators of school mental health and well-being, and stress, we decided to analyze each quantitative dependent variable (DV) using Student T-tests (independent variable group with two categories). Prior to this, normality of distribution was checked using a normal probability plot with Henry's line, and a Levene's test was performed to ensure homogeneity of variance. A gender-differentiated analysis was conducted to meet the research policies of the UN convention (UNO 1989). It takes into account the realities of gender differences to better adapt policies and recommendations to the reality of the population (Massé and Massé 2005).

Results

Quality of interactions in the classroom (CLASS)

Figure 3 shows the mean scores (M = mean) for each dimension measured (emotional support, classroom organization, instructional support) by group (flexible and fixed). Higher values on all three dimensions were observed for the flexible group compared to the fixed group. Means were higher for the *emotional support* dimension for the flexible group ($M = 4.3$; $SD = 1.5$) compared to the fixed group ($M = 3.3$; $SD = 0.9$), higher for the *classroom organization* dimension ($M = 5.9$; $SD = 0.2$) compared to the fixed group ($M =$

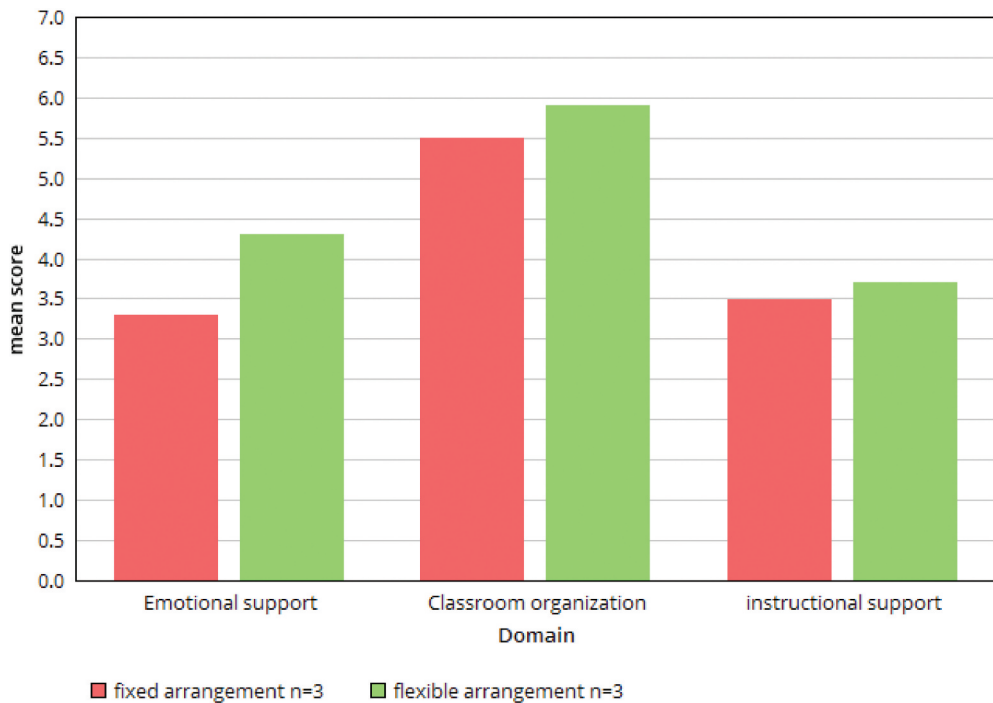


Figure 3. Mean scores for quality of classroom interaction by dimension by group.

5.5; SD = 0.5), and higher for the *instructional support* dimension ($M = 3.7$; SD = 1.2) compared to the fixed group ($M = 3.5$; SD = 1.1). A difference could thus be noted between the groups.

Mental health indicators

Results for both genders

Table 2 presents data on mental health indicators for all students by group (fixed/flexible). A downward trend in the flexible seating group for *internalizing problems* could thus be noted. This means that students in the flexible seating group tended to report less atypical behavior, social stress, and anxiety and depression, but this difference was not statistically significant (p-value = 0.740). The mean score for *inattention/hyperactivity* was lower in the fixed seating group than in the flexible seating group, and this difference was not statistically significant (p-value = 0.618). For *school problems*, which include attitudes toward school and teachers, the flexible seating group had a lower mean score (p-value = 0.426). The mean score for *emotional symptoms* (stress, depression and anxiety, feelings of failure) was slightly lower in the flexible seating group (p-value = 0.901).

Results for boys

Table 3 presents the mental health indicators by group for boys. The average score for *internalizing problems* was higher and statistically significant (p-value = 0.02) in the flexible seating group compared to the fixed seating group. Boys in this group also reported more *inattention and hyperactivity* (p-value < 0.01).

For the *school problems* variable, boys in the flexible seating group had a lower average score compared to those in the fixed seating group (p-value = 0.45). As for the *emotional symptoms* variable, boys in the flexible seating group had a higher mean score compared to the fixed group (p-value < 0.01).

Table 2. Mental health indicators by group (fixed and flexible seating).

	Fixed group (N = 51)	Flexible seating group (N = 56)	
Mental health indicators	Mean (SD)	Mean (SD)	p-value
Internalizing Problems	53,1 (11,7)	52,4 (10,5)	0,740
Inattention/hyperactivity	50,9 (9,30)	51,9 (11,0)	0,618
School Problems	49,3 (9,19)	48,0 (8,04)	0,426
Emotional symptoms	51,5 (11,0)	51,3 (10,6)	0,901

Note. * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$.

Table 3. Mental health indicators by group for boys.

	Fixed group (N = 27)	Flexible seating group (N = 30)	
Mental health indicators	Mean (SD)	Mean (SD)	p-value
Internalizing problems	50,2 (9,86)	56,8 (10,3)	0,02*
Inattention/hyperactivity	50,7 (7,99)	57,2 (10,3)	0,01**
School problems	53,1 (9,25)	51,3 (8,51)	0,45
Emotional symptoms	48,9 (8,69)	55,6 (11,1)	0,01**

Note. * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$.

Table 4. Mental health indicators by group for girls.

	Fixed group (N = 24)	Flexible seating group (N = 26)	
Mental health indicators	Mean (SD)	Mean (SD)	<i>p</i> -value
Internalizing problems	56,3 (12,9)	47,0 (8,01)	0,004**
Inattention/hyperactivity	51,2 (10,8)	45,8 (8,33)	0,05*
School problems	45,1 (7,19)	44,1 (5,46)	0,61
Emotional symptoms	54,5 (12,7)	46,3 (7,58)	0,01**

Note. * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$.

Results for girls

Table 4 presents the mental health indicators by group for girls. We observed that many variables were statistically significant. Girls in the flexible seating group tended to report less feelings of inadequacy, social stress, and anxiety and depression (*internalizing problems*), and did so in a statistically significant manner (p -value <0.01). Also, girls in the flexible seating group reported fewer *inattention/hyperactivity* (p -value = 0.05). Regarding *school problems*, girls in the flexible seating group had a slightly lower mean score (p -value = 0.61). Finally, girls in the flexible seating group reported fewer *emotional symptoms* compared to the fixed group (p -value <0.01).

Nocturnal heart rate variability (nHRV)

The nHRV results were obtained from a total of 45 students (Flexible: $n = 26$; Fixed: $n = 19$). It would have liked to observe lower scores reflecting a more optimal state. The mean score for the flexible group was 58.3 points (SD = 8.51) and 58.4 points (SD = 10.9) for the fixed group (p -value = 0.974).

Regarding the nHRV for girls (Flexible: $n = 12$; Fixed: $n = 11$), no difference was observed between the flexible group ($M = 58.9$; SD = 12.0) and the fixed group ($M = 58.8$; SD = 15.7) (p -value = 0.991). For boys (Flexible: $n = 14$; Fixed: $n = 8$), a similar percentage was found between the flexible seating group ($M = 57.88$; SD = 4.16) and the fixed seating group ($M = 57.8$; SD = 10.9), though with a greater SD for the fixed seating group.

Discussion

The purpose was to examine the role of flexible seating on classroom interactions and on the school mental health.

The results of classroom interactions showed a trend between the two groups. It points to an increase in scores for emotional support, classroom organization, and instructional support in the flexible seating classrooms.

When looking at school mental health indicators (regardless of gender), although the results were not statistically significant, we observed a positive influence on mental health indicators. Only the variable *inattention/hyperactivity* had a higher mean score in the flexible group.

When the results were compared, according to gender, it was observed that girls in the flexible classrooms had lower mean scores for: *internalizing problems*, *inattention/*

hyperactivity, school problems and emotional symptoms. Conversely, boys in the fixed classrooms presented lower scores for the above variables.

Flexible classrooms (learning space) seem to have an impact on school mental health and on classroom interactions. It is consistent with what have been found in the literature. Indeed, flexible seating, which is student-centered (Kariippanon et al. 2018, 2019; Norazman et al. 2019), help teachers to meet the needs of students especially in learning (Curby, Rimm-Kaufman, and Abry 2013; Havig 2017; Kariippanon et al. 2018, 2019) and to build a cooperative space for students (Havig 2017). It can facilitate emotional interaction and create a positive relationship providing better instructional support (Curby, Rimm-Kaufman, and Abry 2013; Havig 2017; Kariippanon et al. 2018, 2019). A positive relationship promotes better socio-emotional development and well-being (Konu and Rimpala 2002; Hamre and Pianta 2006; Corbin et al. 2020). It, also, leads to a greater engagement (Hardin 2017; Baudoin and Galand 2018; Boulton et al. 2019; Anderson and Hartley 2019; Pedler, Yeigh, and Hudson 2020), which increases the perceived well-being improving mental health indicators in flexible classrooms as we've seen (Kariippanon et al. 2018; Anderson and Hartley 2019).

Additionally, this layout encourages participation, to make decisions together, and increase feelings of belonging (Baudoin and Galand 2018; Havig 2017). Furthermore, to encourage student engagement in their tasks, classroom arrangement should be determined by the nature of the instructional activity. For example, when students have individual work, the best is to use an arrangement where they can work alone (O'Mahony and Siegel 2008; Wannarka and Ruhl 2008; Simmons et al. 2015; Havig 2017). Conversely, a circle arrangement allows for better student interaction and participation (Wannarka and Ruhl 2008; Havig 2017).

All of this increase student engagement, motivation and ultimately student well-being.

In sum, a flexible seating classroom can accommodate students' physical, cognitive, and social needs, resulting in improved behavior and maintenance of mental health (Abbasi 2013; Comaianni 2017; Limpert 2017; Legout 2018; Sorrell 2019).

However, as we can see, for some students this kind of classroom is not suitable. The difference in results between girls and boys shows us how important it is to conduct a gender analysis in research as much as possible.

The lower mental health of boys in the flexible seating group compared to boys in the fixed seating group does not appear to be explained by socioeconomic background. The boys in the flexible classrooms were from the most advantaged schools and reported more internalizing problems, attention problems with or without hyperactivity, and emotional symptoms. Difficult socioeconomic conditions in the family environment increase exposure to factors that can negatively impact the well-being, mental health (Couture 2019; Riberdy, T treault, and Desrosiers 2013), and academic success (as quoted in Ayotte, Fournier, and Riberdy 2009). Indeed, youth from low socioeconomic backgrounds are more exposed to stress and difficult life experiences that can have negative effects on their mental health (as quoted in Ayotte, Fournier, and Riberdy 2009). However, the results of our study for boys do not corroborate these studies. Furthermore, the differences in results, obtained between gender, can be explained by their different responses to various stressors and the different ways they adapt to situations. Indeed, girls perceived in more positive way interaction with teacher and the instructional support (Corbin

et al. 2020). They, compared to boys, have more intra-individual skills (control of themselves, dedication, curiosity, etc.) and inter-individual skills (problem-solving, sociability, communication, etc.) developed (Besnard, Lemelin, and Houle 2016; Fanchini and Morlaix 2021). All these skills are important because they allow an easier adaptation to the environment.

Analysis of nocturnal heart rate variability was performed on a subsample of 45 out of 107 students and showed no differences between groups for both genders. Girls had a slightly higher percentage of nHRV compared to boys. This may be because, in general, girls have higher levels of stress. In its 2018 survey, the ISQ reported a higher percentage of anxiety disorders in girls than in boys (22.9 % vs. 11.8 %) (Julien 2018). Added to this is the fact that girls experience body changes (due to puberty) earlier (2 years) than boys do. These bodily changes result, in particular, in lower self-esteem than for boys (Seidah, Bouffard, and Vezeau 2004). Studies have found that low self-esteem increases cortisol levels (hormone linked to stress) and is associated with poorer stress management (Galanakis et al. 2016; Kogler et al. 2017). Indeed, puberty puts pressure on the body and has an influence on reactivity to stress. One study showed that girls on average secrete more cortisol boys. The findings are consistent with other studies showing that waking cortisol secretion is higher in post-pubertal girls compared to post-pubertal boys (Netherton et al. 2004).

One of the limitations is that the sample available for statistical analysis of nHRV variable did not include the entire baseline sample. Also, a bias in variance estimation should be noted since the statistical analysis of student data was performed at the individual level rather than taking into account sample clusters. Moreover, all participants were included without taking into account those undergoing medical treatment for these problems.

Conclusion

Flexible seating classroom had an impact both on student-teacher interaction and mental health. More precisely, this kind of classroom layout seems to have a positive effect for girls but not for boys. It appears that flexible seating arrangement is not for everyone. For some students presenting a lack of autonomy or who need more structure, a fixed seating classroom could be a better choice.

In practice teachers should consider that some of their students may not feel comfortable in a flexible layout. More support and help from the teacher to these students could help them to cope with the changes brought by flexible seating.

Beyond the students' comfort, for teachers, this would allow them to meet their students' needs through differentiated instruction and differentiated learning.

Initially, two times of measures were planned. The second measurement time (T2) should have been in mid-2020. Due to the pandemic, it was impossible to do T2 since the schools were closed. Also, conducting a longitudinal study will be very interesting to observe any changes over time.

Disclosure statement

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