

Investigating the impact of Flexible Furniture in the Elementary Classroom.

Shanna L. Attai
Baylor University

Jorge Carmona Reyes
Baylor University

John L. Davis
University of Utah

Judy York
Education Service Center Region 12

Kerri Ranney
Huckabee Inc.

Truell W. Hyde
Baylor University

Author Note.

Shanna L. Attai, Center for Astrophysics, Space Physics, and Engineering Research, Baylor University; Jorge Carmona Reyes, Center for Astrophysics, Space Physics and Engineering Research, Baylor University; John L. Davis, Department of School Psychology, University of Utah. Judy York, Education Service Center Region 12; Kerri Ranney, Huckabee Inc.; Truell W. Hyde, Center for Astrophysics, Space Physics and Engineering Research, Department of Physics, Baylor University

The authors disclose receipt of the following financial support for the research, authorship, and/or publication of this article. This research was funded in partnership by Huckabee Inc., Education Service Center Region 12 (ESC Region 12), Midway ISD (MISD) and Baylor University. The opinions expressed are those of the authors and do not represent views of Huckabee Inc., ESC Region 12, MISD, or Baylor University.

Correspondence concerning this article should be addressed to Shanna L. Attai, Center for Astrophysics, Space Physics and Engineering Research, Baylor University, One Bear Place #97283, Waco, TX 76798, Shanna_Attai@baylor.edu, (254)-710-2516.

Author Emails: Shanna_Attai@baylor.edu; Jorge_Carmona_Reyes@baylor.edu; davis.john@utah.edu; jyork@esc12.net; kranney@huckabee-inc.com; Truell_Hyde@baylor.edu

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Investigating the impact of Flexible Furniture in the Elementary Classroom

Abstract

Educators are beginning to consider the physical learning environment as an additional resource to meet the learning outcomes in modern classrooms. In order to better utilize classroom space, schools have begun to eliminate desks and chairs replacing “traditional” furniture with “flexible” furniture, capable of multiple reconfigurations to facilitate teaching and learning. The impact of flexible furniture in elementary classrooms has little exploration. This study investigates the various impacts flexible furniture paired with teacher professional development (PD) can have on the elementary classroom. A total of ten classrooms were included in the study with 3rd and 4th graders ($N = 206$ students). Classrooms were observed biweekly for eight weeks and assigned to one of two groups: Group A received Professional Development (PD) and flexible furniture while Group B maintained traditional furniture. During observations three students were randomly selected per classroom and continuously monitored throughout each observation ($n = 30$ students). This study is twofold, first, a between-groups design and an analysis of covariance (ANCOVA) was employed to assess the effect of the intervention using pre-intervention self-assessment results as the covariate. As predicted, students who experienced flexible furniture reported greater satisfaction with the learning environment than did peers with traditional furniture. Secondly, a series of independent samples t-test demonstrated classrooms with flexible furniture provided more opportunities for student autonomy and use of furniture for learning. Insight on flexible furniture, its impact in the elementary classroom and implications and future research are discussed.

Keywords: Flexible Furniture, Learning environment, Elementary-aged students, Teacher professional development

Investigating the impact of Flexible Furniture in the Elementary Classroom

In an effort to increase engagement in educational settings, educators are beginning to examine the use of space in schools and specifically the classroom physical learning environment. Following the “twenty-first century” classroom approach, teachers and students are encouraged to become active learning participants with a more student-centered approach, requiring physical space and furniture that supports this goal (Kariippanon, Cliff, Lancaster, Okely, & Parrish, 2018). To move towards such student-centered learning, schools and educators have recently begun to modify the learning environment to meet the needs of twenty-first-century learners and increase student engagement and academic achievement. As part of this process, researchers have suggested changes to the learning environment that include improving teaching practices, increasing incorporation of technology and modifying the built (physical) classroom environment (Cleveland & Fisher 2014; Kariippanon et al., 2018).

The most recent trend in learning environments involves replacing “Traditional Furniture” (e.g. stationary desks and chairs), with work surfaces providing students a choice of seating, location and comfort. This will be defined in this study as "flexible furniture" i.e., work surfaces and seating that provides and supports student choice of seating, location, and comfort encouraging classroom peer interaction, fostering collaboration and empowering students to become builders of knowledge. In such environments, students are able to move easily, reconfigure, and even partially-condense the furniture within a short period as compared to the time of a class period. Additionally, teacher space within a flexible classroom usually takes ten percent or less of the floor space and to the extent possible is moveable or reconfigurable. Currently, in PK-12 schools, both the physical learning environment and classroom furniture at the elementary level and its effect on students' perception of their environment has been only minimally examined. This study examines the differences between flexible and traditional furniture and examines the manner in which flexible furniture impacts elementary students' perception of environment and engagement.

Traditional Classroom Furniture

The traditional classroom furniture used in most educational systems was designed during the industrial economy. Furniture arrangements were characterized by rows of stationary desks and chairs (often bolted in place) and matched the economic, social, technological, and demographic needs of society (Kariippanon, et al., 2018). Traditional classroom environments enabled teachers to deliver content to large groups of students in a lecture format (Cornell, 2002). Although, traditional furniture does not allow movement for students and can reduce

attention and on-task behavior and despite changes in pedagogy, traditional classroom furniture remains the primary design for the majority of learning environments. (Higgins, Hall, Wall, Wooler, & McCaughey, 2005).

Flexible Classroom Furniture

As educators continue to look to create learning environments conducive to active learning, concerns about space utilization, facilities, and furniture have arisen. This is due in part to the difficulties which arise when teachers implement student-centered pedagogies in classrooms designed for direct teach modalities. Therefore, there is an effort to combine architectural design with best practices in teaching and awareness to determine the role the physical learning environment has on students (Buckley, Schneider, & Shang, 2005; Cleveland, 2011; Cleveland & Fisher, 2014; Fisher, 2004; Hartnell-Young, 2006; Heppell, Chapman, Millwood, Constable, & Furness, 2004; Higgins et al., 2005; Rands & Gansemer-Topf, 2017; Taylor, 2009).

As the use of flexible furniture in elementary schools continues to evolve, the majority of research on these types of enhanced learning environments has been focused at the university level. Throughout the literature, these new learning environments are defined and identified by both their furniture and design to encourage active learning through constructivist pedagogies. As such, there is no universally accepted definition of these new learning environments; however, most have common names such as "flexible learning spaces" (Karripanon et al., 2018), "active learning classrooms" (Beichner, 1991; Beichner et al., 2007; Baepler, Walker, Brooks, Saichaie, & Petersen, 2016), or "interactive learning spaces" (Thomas, Pavlechko, & Cassady, 2018). In the learning environment literature, studies are also beginning to document the relationship between the physical or built learning environment and how it can enhance pedagogy and therefore influence student outcomes (Cleveland, 2011; Fisher, 2005; Jamieson, Dane, & Lippman, 2005; Clinton & Wilson, 2019; Blackmore, Bateman, Loughlin, O'Mara, & Aranda, 2011).

In fact, when classroom layouts are designed thoughtfully, learning environments have been shown to facilitate student-centered teaching leading to improved student engagement (Cleveland, 2011; Stern & Etheridge, 2008). As a representative example, Gifford (2002) found that open learning environments, classroom space, and flexibility in furniture arrangement can have positive effects on learning outcomes. Recent trends in classroom seating (i.e., alternative seating options) have since emerged from occupational school therapists and been shown to improve adaptive behaviors, with some studies examining the relationship between "alternative seating" and its effect on learning across a variety of student populations (Merritt, 2014; Schilling & Schwartz, 2004). Furthermore,

flexibility in the classroom is proving an essential tool for teachers attempting to provide a variety of activities to meet the learning needs of all students (Barrett et al., 2015). This is evidenced by the percent increase in the literature exploring how to engage students actively in their learning, and create active learning classrooms (Beichner, 2006).

Current Study

With more schools beginning to redesign their learning environments through implementation of flexible furniture, it is important to focus on the influence this furniture has on the students within the learning environment. To date, only a limited number of studies have evaluated the benefits associated with modifications of the physical learning environment (Bagatelli, Mirigliani, Patterson, Reyes, & Test, 2010; Pfeiffer, Henry, Miller, & Witherell, 2008; Stapp, 2008). Since elementary students spend the “majority of their time in one classroom” throughout the school day it is important that the impact the learning environment has on those students is understood (Barrett, Zhang, Moffat, & Kobbacy, 2013, p.11). The purpose of this study was to examine the impact that implementation of flexible classroom furniture in conjunction with teacher professional development has on students in comparison to peers in classrooms having traditional furniture (i.e., stationary desks and chairs). This study also examines an intervention, including teacher professional development in conjunction with flexible furniture and the impact the combination has on the learning environment in the elementary grades. A proper understanding of how the two work together to impact the elementary classroom will enable educators to redesign learning environments, while developing curriculum and teacher professional development to enhance the overall learning experience for elementary students. Ultimately, this should in turn lead to higher levels of student engagement and academic achievement. Thus, this research has the potential to add to the learning environment literature, providing empirical evidence that can be used by school administrators in future facility planning and renovations. This research should also serve as a stepping stone that will assist in refining and identifying the relationships between learning environments and elementary students' engagement and outcomes.

Specifically, the primary purpose of the current study is to determine whether flexible classroom furniture used by teachers after appropriate professional development (PD), enhances active learning through movement, student choice, and/or increases students' perception of the environment in the elementary classrooms. It is hypothesized that training elementary school teachers in the use and equipping their classrooms with flexible furniture will have a significant positive impact on student perception of the learning environment when compared

to students in classrooms equipped only with traditional furniture. It is also hypothesized that students in classrooms equipped with flexible furniture will perceive their classroom environments differently than do their peers in traditional classrooms. The research questions to be addressed are:

1. Do students in classrooms with flexible furniture compared to classrooms with traditional furniture perceive their environment differently?
2. Do students in classrooms with flexible furniture move more without reprimand compared to their peers in traditional classrooms?
3. Are students in classrooms with flexible furniture given more autonomy and ownership of the learning environment compared to their peers in traditional classrooms?

Methods

The proposed study aims to assess the impact flexible furniture has on the student movement, choice, and perception of the learning environment among elementary students. This study used a between-groups research design involving ten classrooms. Before the beginning of the study, IRB approval was obtained from both the University and participating school district.

Data were collected in two parts through self-reported student survey data and classroom observations. The survey data sample size included total recruitment of ten 3rd and 4th-grade classrooms ($N = 10$ classrooms; $N = 206$ students) with the sample for the observation data taken from each of the ten participating classrooms. At the onset of the study, three students were randomly selected from each participating classroom and continuously monitored throughout each observation ($n = 30$ students). Classrooms were observed biweekly for eight weeks and assigned to one of two groups. Group A (the intervention group) received both PD and flexible furniture ($n = 4$ classrooms) while Group B maintained treatment as usual (tau group) and their original (traditional) classroom furniture provided by the school district ($n = 6$ classrooms).

Participants

Participants were recruited from an elementary school in the Southwestern United States. The selected elementary campus is a public elementary school located in a suburban city within the southern region of the United States. The school campus demographics are as follows: African American 12.0%, Hispanic 26.1%, White 44.6%, American Indian 0.4%, and Asian 3.3%. The campus reports 35.0% of students to be economically disadvantaged, and 6.0% are English language learners. The campus has a mobility rate of 11.4%.

The parents of all students were provided detailed information regarding their child's participation in the study before the start of the school year. Parents choosing not to have their students participate in the study were opting out of their child completing the student surveys, not out of specific classrooms or teachers. A student was included in the study as a participant if the student's guardian did not sign a participant opt-out form. Collected data included a total recruitment of $N = 10$ classrooms with $N = 206$ student participants.

Data Collection

Total participation included 206 elementary students in third and fourth grade. Data were collected in two ways. First, all participating students completed online surveys at the onset of the study and pre-intervention on their perceptions of their classroom learning environment. At the end of the eight-week study, student surveys were re-administered post-intervention. Participating students completed the survey during the fall semester with survey administration taking place in the computer lab. Students used individual computers to complete an online survey; items were formatted using *Qualtrics*, formatted one per page and presented in a unique random order within each measure for each student. Students were closely monitored by the survey administrator, who made efforts to control careless responding and assist students when necessary with technical or reading support.

Secondly, data was collected through outside observers for each of the participating classrooms. During observations, the observer randomly selected three students from each classroom at the onset of the study. The same three students were continuously monitored each time during each observation. During the study, classrooms were observed every other week for eight weeks (approximately four observations per classroom). During each observation, one trained observer observed the class for a total of twenty minutes and completed the developed observation form in the classroom environment. No instruction time was lost or interrupted during observations.

Measures

Learning Environment Student Survey. A survey was created to assess students' opinion about their classrooms, specifically the general perceived "comfort of the classroom furniture". This survey was unidimensional and contained seven items (7 items; Cronbach's $\alpha = .72$). For each of the items, participants were asked to indicate their level of agreement with all items scored using a 4-point Likert-type rating scale (1 - *Never*, 4 - *Almost Always*). Items were coded so that higher scores indicated higher levels of comfort in the learning environment. Perception of the environment was measured by the *Learning Environment Student Survey (LESS)* with students reporting on their physical comfort in the classroom, ability to focus, enjoyment in the environment, and feelings towards the

furniture, and rating their perception of their classroom as fun. To eliminate bias, each item developed for the survey was reviewed by a group of culturally diverse teachers, representing various ethnicities and genders. For consistency of administration, all students completed the surveys during their computer class period with survey links emailed to campus teachers and then airdropped onto student computers.

Classroom Observations. An observation form was designed specifically for the study, to assess the dependent variables of student movement and aspects of student autonomy (e.g. student seat choice and work surface choice). All observers were trained prior to implementing the observation protocol. Over the course of the study, 112 total observations were conducted. Inter-observer agreement was conducted on 20% of the observation sessions (23 sessions). Percent agreement (% agree) was calculated as the number of agreements between observers over the total number of observations. Inter-observer results are as follows: Student movement = 94.4%; Seat choice = 83.3%; Work surface choice = 86.1%.

Flexible Environment Learning Scale. Before the beginning of the study, researchers inventoried all classrooms using the *Flexible Environment Learning Scale (FELS)* (Figure 3) to account for "classroom hacks" that could be a moderator or mediator variable in the study and influencing the results, if not considered before collecting data. Since classrooms are on a spectrum of agility and flexible furniture is more sophisticated than a Yes/No designation the *FELS* was used to account for tau classrooms that might have a few components of flexible furniture.

All four intervention classrooms were rated as highly flexible, and all six tau classrooms were identified as having no flexibility or low flexibility. Classroom furniture with *High Flexibility* was considered the gold standard with 14-15 total points on the flexibility rubric. Furniture with 10-13 total points was designated as *Some Flexibility*, providing recognition to classrooms trying to obtain flexibility on limited budgets. Furniture with 1-9 total points was identified as *Low Flexibility* and allowing credit to classrooms trying to achieve flexibility on minimal budgets. Furniture with 0 total points was designated as *No Flexibility*. The *FELS* was developed by the Learning Experience collaborative to inventory classrooms participating in the study (tau and intervention). The scale was taken directly from the definition, as mentioned earlier of flexible furniture and was used to inventorying all participating classrooms.

Data Analysis Plan

Following data collection, all raw data was input into an Excel spreadsheet then uploaded in IBM SPSS Statistics for Windows Version 25.0 for analysis.

Independent variable. The independent variable in the study was exposure to flexible furniture and teacher professional development (PD). Flexible furniture was provided to participating teachers free of charge from various vendor donations and Huckabee, Inc. In this study, flexible furniture is defined as furniture (work surfaces and seating) that provides and supports students' choice of seating, location, comfort, and classroom peer interaction with the intent of fostering collaboration and empowering students to become builders of knowledge. Additionally, students should be able to easily move, reconfigure and partially condense the furniture in a short period of time in comparison to the time of a class period. Teacher space within a flexible classroom should take up to 10% or less of the floor space and to the extent possible be moveable or reconfigurable. All intervention teachers received a full day of PD, focused on the utilization of flexible furniture in the elementary classroom to enhance lessons and encourage student voice/choice developed by the Education Service Center Region 12 (ESC Region 12).

Dependent variables. The dependent variables were the general perception of the environment, student movement, and student choice. The previously mentioned measurement tools measured the dependent variables.

Results

The purpose of this study was to investigate the impact flexible furniture has in the elementary classroom. The study hypothesized that students in classrooms with flexible furniture would report greater satisfaction with the environment than peers placed in classrooms with traditional furniture or tau classrooms. The data were analyzed in two ways. First, survey data was analyzed using an analysis of covariance (ANCOVA), and observation data was analyzed using a series of independent samples t-test.

Student Surveys

Student Perceptions of Learning Environment. To answer the first research question, an analysis of covariance (ANCOVA) was used to assess the effect of the intervention using pre-intervention self-assessment results as the covariate. Descriptive data and the Hedges' *g* effect size were used to calculate the magnitude of difference between the group scores. Using student self-ratings as the outcome, students in the intervention condition had higher average ratings ($M = 21.15$, $SD = 4.5$) than did the students in the tau condition ($M = 20.73$,

$SD= 4.52$). A small effect size ($g = .09$) was found between conditions. When examining test scores, the ANCOVA analysis also revealed significant results for the overall model ($F(1, 160) = 9.89, p = .02$).

The study provides supportive data that flexible furniture in the learning environment has the potential to create learning environments that can influence students' perception of their classroom and ultimately their feelings towards school. Students in intervention classrooms reported an increase in perception of their general classroom environment after exposure to flexible furniture. Students in intervention classrooms also expressed more comfort after exposure to flexible furniture and reported being more attentive and less distracted by furniture. Students in the intervention classrooms also reported higher levels of enjoyment in the environment, liked the classroom furniture, and thought the classroom was fun. These findings also provide support for schools and teachers wishing to utilize PD training before implementing flexible furniture in the classroom to enhance the impact the furniture has on students in the elementary classroom.

Classroom Observations

The second and third research questions were answered through data collected from classroom observations and analyzed using a series of independent samples t-test (Table 1).

Student Movement. During classroom observations, it was observed that intervention classrooms with flexible furniture allowed students to have more opportunities for movement without reprimand or consequences. An independent samples t-test was conducted to compare student movement without reprimand in intervention classrooms with flexible furniture and tau classrooms. There was a significant difference in the scores for intervention classrooms ($M = .84, SD = .36$) and tau classrooms ($M = .10, SD = .32$); $t(144) = 16.83, p = 0.00$. The results suggest that classrooms with flexible furniture effect student movement. Specifically, the results suggest that in classrooms equipped with flexible furniture, students move more freely without reprimand from the teacher.

Student Autonomy. During classroom observations, students in classrooms with flexible furniture were given more opportunities to take ownership of their environment through choice in seating and work surfaces than peers in traditional classrooms.

Seat choice. To support student autonomy intervention classrooms equipped with flexible furniture provided a variety of seat choices, including more seats open than being used, a variety of heights in seating options, and various types of seating (soft, active, standard). An independent samples t-test was conducted to compare both the intervention and tau classrooms and examine the difference in allowing students to choose their seat to sit in

throughout the class day. There was a significant difference in the scores for flexible furniture classrooms ($M = .88$, $SD = .33$) and tau classrooms ($M = .09$, $SD = .28$); $t(139) = 21.031$, $p = 0.00$. The results suggest that classrooms with flexible furniture have an effect on student choice. Specifically, the results suggest that when classrooms are equipped with flexible furniture teachers allow students to explicitly choose their seat independently throughout the day and change seats during the day to accommodate their learning needs and comfort level.

Work surface choice. An independent samples t-test was conducted to compare the differences in the choice of student work surfaces in intervention classrooms with flexible furniture and tau classrooms. Work surfaces included traditional stationary desks in tau classrooms or a variety of height-adjustable tables, flip tables, and writable tables/surfaces in intervention classrooms. Intervention teachers allowed students to specifically choose a work surface throughout the day to accommodate their learning needs and preferences more often than tau classrooms. There was a significant difference in the scores for intervention classrooms with flexible furniture ($M = .73$, $SD = .44$) and tau classrooms ($M = .03$, $SD = .19$); $t(103) = 14.99$, $p = 0.00$. The results suggest that classrooms with flexible furniture have an effect on student choice for work surfaces. Specifically, the results suggest that when classrooms are equipped with flexible furniture teachers allow students to explicitly choose their work surface independently throughout the class day based on the activity they are participating in and comfort level

Table 1

Independent sample t-test results for classroom observation data

Variable	Group ^a	M	SD	df	t	p
Student movement	Intervention	.84	.36	144	5.17	0.00
	Tau	.10	.32			
Seat choice	Intervention	.88	.33	139	21.031	0.00
	Tau	.09	.28			
Work surface choice	Intervention	.73	.44	103	14.99	0.00
	Tau	.03	.19			

^a $n = 30$ students

Discussion

The purpose of this paper was to identify the impact flexible furniture has on student movement, student autonomy, and student perception of the learning environment in the elementary classroom in comparison to classes maintaining their traditional furniture. In doing so, an operational definition of flexible furniture was provided and a scale for inventorying and identifying the level of flexibility in elementary classrooms. Finally, two new measure to

evaluate self-reported student perception on the environment and an observation form for observing student movement and autonomy in a flexible learning environment was developed and employed.

First, students' perception of their learning environment was examined. As hypothesized, students in classrooms equipped with flexible furniture perceived their classroom as more comfortable than did students in classes that maintained the traditional furniture provided by the school district. These findings are consistent with previous studies conducted at the university level reporting that in "active learning" classrooms students reported higher levels of intrinsic value than peers in traditional lecture-style classrooms (Clinton & Wilson, 2019). Furthermore, students are consistently more satisfied in classrooms when factors such as seating, lighting, and temperature are evaluated (Yang, Becerik-Gerber, & Mino, 2013)

One possible reason that students in classrooms equipped with flexible furniture perceived the furniture and their environment differently than did their peers using traditional furniture is that the flexible furniture was new and more colorful which could have led to a novel effect. Similarly, several studies conducted at the postsecondary level report aspects of redesigned learning environments that include flexibility of space, writable surfaces, and technology access have resulted in improved student engagement and enthusiasm towards learning (Jankowska & Atlay, 2008). Students participating in a study in university classrooms reported active learning classrooms as more enjoyable and aesthetically pleasing than traditional lecture rooms due to design (Clinton & Wilson, 2019). However, such newer classrooms equipped with active learning furniture were not perceived differently than traditional lecture classrooms in terms of comfort by the students (Clinton & Wilson, 2019). Students in both classrooms commented on how the seating was uncomfortable. These findings, along with others, suggest that furniture and possibly classroom design are factors in students' perception of their classroom learning environment (Matthews, Andrews, & Adams, 2011).

Secondly, the intervention classrooms equipped with flexible furniture were purposefully designed to facilitate student movement and comfort through offering a variation in agility and adjustability. Students in classes with flexible furniture were allowed freedom to move throughout the day without reprimand. Congruent with these findings, a qualitative study revealed learning environments equipped with "active" furniture could be used to provide opportunities to move around the classroom as well as create more opportunities for collaborative learning among peers than traditional lecture classrooms. (Parson, 2017; Rands & Gansemer-Topf, 2017). This study adds to the literature suggesting students who have the freedom to move and be physically active

throughout the class day perceive their environment as more enjoyable and more comfortable during the school day. Positive perceptions of the environment along with classrooms designed to get kids up and moving around might, in turn, lead to more opportunities for students to collaborate and communicate leading to deeper connections among peers and teacher.

Also, this study supports the hypothesis that teacher professional development is an essential component when implementing new classroom interventions or resources, including furniture. In this study, the PD offered to the intervention group encouraged teachers to examine and reevaluate classroom management techniques that would allow students the freedom to move and utilize the flexible furniture to build student autonomy and promote activity. Other studies have found that teachers working in new learning environments designed with technology as an emphasis have been exposed to PD programs to help teachers develop a framework for problem-based lessons that incorporated real-world resources and experiences into the unit. Doing so resulted in higher levels of engagement in students and students were able to critically examine community and global issues in the technology classrooms in comparison to teachers in the traditional classrooms (Lowther, Ross, & Morrison 2003). The results of this study and the current research suggest that new learning environments require noticeably different teaching pedagogy and management for students.

Finally, we considered the impact that flexible furniture has on student choice in seating and work surfaces throughout the school day. The classrooms were designed to support student choice by offering a variety of seating choices, more seats available to students than being used, a variety of height in seating options and various types of seating (soft, active, standard). Similarly, a qualitative study interviewing teachers reported having the ability to express a choice in where they want to sit and how they want to work was essential to many teachers. Two teachers, in particular, revealed that student autonomy was the most critical feature in promoting student engagement (Gunderson, 2019). Furthermore, professors reported allowing choice in seating or offering a variety in seating options promoted a learning environment for college students targeted to meet their various needs (Matthews, Andrews, & Adams, 2011). For example, work surfaces (such as writable tables) and standing height tables, soft upholstered seating, and rocking chairs allowed students to choose spots unique to their comfort and learning styles (Matthews, Andres, & Adams, 2011). The present study's findings along with others suggest that having an architectural design that facilitates movement and choice through flexible furniture can begin to blur the

"line between instructor and students" creating an environment that creates authentic community among students and teachers (Talbert & Mor-Avi, 2018, p. 29).

Limitations of the Study and Future Research

As with all research, the present study has limitations. Ideally, it would have been best to use a probabilistic sampling method; however, the researchers did not pursue a random sample due to the cost, difficulty, and timeliness associated with random sampling. The major drawback to using convenience sampling is sampling bias because the sample is less likely to be representative of the entire population, limiting generalizations and inferences that might be made about the whole population. Future replications will need to be conducted across a variety of PK-12 settings and a variety of cultural contexts to increase the level of generalizability of the results.

Due to this, the findings of this study can only be generalizable to similar samples as the present study. Future research is needed to expand on our understanding of flexible furniture and the various ways it impacts students' outcomes such as academic outcomes and student engagement. Student engagement was not examined in this study; however, future studies could assess whether flexible learning environments increase student engagement at the elementary level.

Conclusions

The current study draws three main conclusions: 1) Students in flexible learning environments have a definite increase of perception regarding the classroom environment over time in comparison to peers in traditional learning environments, 2) flexible furniture in classrooms provide more support for student choice and movement than do classrooms with traditional furniture and 3) additional professional development is needed to maximize the benefits associated with flexible furniture in order to enhance learning. These findings are congruent with previous results, showing the need to consider the learning space as an additional component to teacher pedagogy impacting the effectiveness of students' learning experiences (Cleveland & Fisher, 2014). Further examination of these new and redesigned learning environments with the implementation of flexible furniture is essential to help active learning and student-centered environments reach their fullest potential. Furthermore, there is an ongoing need for research and evaluation data in learning environments as decision-makers and school administrators look towards research-based evidence to inform their future decisions.

A variety of stakeholders in education can use the information gained from this research in learning environments. Specifically, this study provides a foundation for delivering useful research to both educators and

architects informing the effectiveness of classroom designs and furniture choices, developing modern or new approaches in furniture and design and enhancing and support educators' pedagogical goals to improve student outcomes. School architects can use this research to inform design decisions and the consultation process with current and future clients, typically school administrators and facility planning committees. School administrators, who are responsible for allocating funds for new facilities and redesigning current facilities might use this data to advocate for modern learning environments equipped with flexible furniture. Finally, this study provides information that can be utilized to guide policymakers' decisions regarding classroom design and equipment.

As such, this study contributes to the learning environment literature by providing supportive data that flexible furniture in classrooms has the potential to create more effective learning environments, improving student perceptions of the environment and student choice, movement, and active learning. Finally, it clarifies that teacher professional development is necessary to optimize the impact furniture has on learning and student engagement. Future research is needed to better understand the connection between teacher professional development and flexible learning environments.

References

- Bagatelli, N., Mirigliani, G., Patterson, C., Reyes, Y., & Test, L. (2010). Effectiveness of therapy ball chairs on classroom participation in children with autism spectrum disorders. *American Journal of Occupational Therapy*, 64, 895–903. doi: 10.5014/ajot.2010.09149
- Baepler, P., Walker, J. D., & Driessen, M. (2014). It's not about seat time: Blending, flipping, and efficiency in active learning classrooms. *Computers & Education*, 78, 227-236. doi.org/10.1016/j.compedu.2014.06.006
- Barrett, P., Zhang, Y., Moffat, J., & Kobbacy, K. (2013). A holistic, multi-level analysis identifying the impact of classroom design on pupils' learning. *Building and Environment*, 59, 678-689.
doi:10.1016/j.buildenv.2012.09.016
- Barrett, P., Davies, F., Zhang, Y., & Barrett, L. (2015). The impact of classroom design on pupils' learning: Final results of a holistic, multi-level analysis. *Building and Environment*, 89, 118-133.
doi:10.1016/j.buildenv.2015.02.013
- Beichner, R., Bernold, L., Burniston, E., Dail, P., Felder, R., Gastineau, J., ... & Risley, J. (1999). Case study of the physics component of an integrated curriculum. *American Journal of Physics*, 67(S1), S16-S24.
- Blackmore, J., Bateman, D., Loughlin, J., O'Mara, J., & Aranda, G. (2011). *Research into the connection between built learning spaces and student outcomes*. Victoria: Department of Education and Early Childhood Development.
- Buckley, J., Schneider, M., & Shang, Y. (2005). Fix it and they might stay: School facility quality and teacher retention in Washington D.C. *Teachers College Record*, 107, 1107–1123.
- Cleveland, B. (2011). *Engaging spaces: Innovative learning environments, pedagogies and student engagement in the middle years of school*. Unpublished PhD thesis, The University of Melbourne, Melbourne, AU.
- Cleveland, B. & Fisher, K. (2014). The evaluation of physical learning environments: a critical review of the literature, *Learning Environments Research*, 17(1), 1 – 28
- Clinton, V., & Wilson, N. (2019). More than chalkboards: classroom spaces and collaborative learning attitudes. *Learning Environments Research*, 1-20.
- Cornell, Paul. (2003). The impact of changes in teaching and learning on furniture and the learning environment. *New Directions for Teaching and Learning*. 92, 33 - 42.
- Fisher, K. (2004). Revoicing classrooms: A spatial manifesto. *Forum*, 46(1), 36–38.

- Fisher, K. (2005). *Research into identifying effective learning environments*. Retrieved from <http://www.oecd.org/education/innovation-education/centreforeffectivelearningenvironmentsce/37905387.pdf>
- Gifford, R. (2002). *Environmental psychology: Principles and practice*. Colville: Optimal Books.
- Gundersen, P. E. (2019). "How Does the High School Redesigned Learning Space Influence Collaboration, Communication, Creativity, and Critical Thinking". Seton Hall University Dissertations and Theses (ETDs).
- Hartnell-Young, E. (2006). Teachers' roles and professional learning in communities of practice supported by technology in schools. *Journal of Technology and Teacher Education*, 14, 461–480.
- Heppell, S., Chapman, C., Millwood, R., Constable, M., & Furness, J. (2004). *Building learning futures*. Retrieved from: www.buildingfutures.org.uk.
- Higgins, S., Hall, E., Wall, K., Wooller, P., & McCaughey, C. (2005). *The impact of school environments: A literature review*. London, UK: The Design Council.
- Jankowska, M., & Atlay, M. (2008). Use of creative space in enhancing students' engagement. *Innovations in Education and Teaching International*, 45(3), 271-279.
- Jamieson, P., Dane, J., & Lippman, P. (2005, May). *Moving beyond the classroom: Accommodating the changing pedagogy of higher education*. Paper presented at the Forum of the Australian Association for Institutional Research in San Diego, CA.
- Kariippanon, K., Cliff, D., Lancaster, S., Okely, A., Parrish, A. (2018). Perceived interplay between flexible learning spaces and teaching, learning and student wellbeing. *Learning Environment Research*, 21, 301-320. doi:10.1007/s1098-017-9254-9.
- Lowther, D. L., Ross, S. M., & Morrison, G. M. (2003). When each one has one: The influences on teaching strategies and student achievement of using laptops in the classroom. *Educational Technology Research and Development*, 51(3), 23-44.
- Matthews, K. E., Andrews, V., & Adams, P. (2011). Social learning spaces and student engagement. *Higher Education Research and Development*, 30(2), 105-120.
- Merritt, J. M. (2014). Alternative seating for young children: Effects on learning. *American Journal of Contemporary Research*, 4(1), 12-18.

- Pfeiffer, B., Henry, A., Miller, S., & Witherell, S. (2008). The effectiveness of Disc 'O' Sit cushions on attention to task in second-grade students with attention difficulties. *American Journal of Occupational Therapy*, 62, 274–281.
- Parsons, C. S. (2017). Reforming the environment: The influence of the roundtable classroom design on interactive learning. *Journal of Learning Spaces*, 6(3), 23-33. Retrieved from <https://eric.ed.gov/?id=EJ1164644>
- Rands, M. L., & Gansemer-Topf, A. M. (2017). The room itself is active: How classroom design impacts student engagement. *Journal of Learning Spaces*, 6(1), 26-33.
- Schilling, D. L. & Schwartz, I. S. (2004). Alternative seating for young children with autism spectrum disorder: Effects on classroom behaviors. *Journal of Autism Developmental Disorders*, 34(4), 423-432.
doi:10.1023/B:JADD.0000037418.48587.f4
- Stapp, A. (2018) Alternative Seating and Students' Perceptions: Implications for the Learning Environment. *Georgia Educational Researcher*. 4(2), 36-47. DOI: 10.20429/ger.2018.140204
- Stern, N. & Etheridge, R. (2008) Flexible Learning Spaces: The Integration of Pedagogy, Physical Design, and Instructional Technology, *Marketing Education Review*, 18(1), 47-53. DOI: [10.1080/10528008.2008.11489024](https://doi.org/10.1080/10528008.2008.11489024)
- Talbert, R., & Mor-Avi, A. (2018, October). A Space for Learning: A review of research on active learning spaces. Retrieved from <https://doi.org/10.31235/osf.io/vg2mx>
- Taylor, A. (2009). *Linking architecture and education: Sustainable design for learning environments*. Albuquerque: University of New Mexico Press. Washington, DC: National Clearinghouse for Educational Facilities.
- Thomas, C., Pavlechko, G., & Cassady, J. (2018). An examination of the mediating role of learning space design on the relation between instructor effectiveness and student engagement. *Learning Environments Research*, 22, 117 – 131. doi:10.1007/s10984-0189270-4
- Yang, Z., Becerik-Gerber, B., & Mino, L. (2013). A study on student perceptions of higher education classrooms: Impact of classroom attributes on student satisfaction and performance. *Building and Environment*, 70, 171-188. doi:10.1016/j.buildenv.2013.08.030

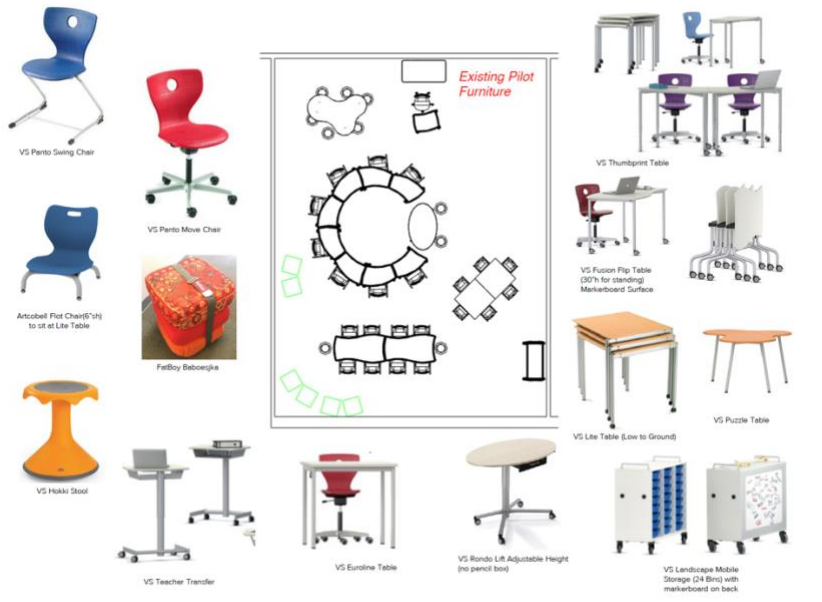


Fig. 1
Flexible Learning Environment for elementary classrooms
Layout designed by Huckabee Inc., furniture by VS and Artcobell



Fig. 2
Traditional Learning Environment for elementary classrooms

No Flexibility (0 pts)	Low Flexibility (1 pt)	Some Flexibility (2 pts)	High Flexibility (3 pts)
Students do not have a choice of work surface, height of work surface, type of seating, or height of seating	Students have at least 1 out of the 4 choices : <input type="checkbox"/> type of work surface <input type="checkbox"/> height of work surface <input type="checkbox"/> type of seating <input type="checkbox"/> height of seating	Students have 2 or more out of the 4 choices : <input type="checkbox"/> type of work surface <input type="checkbox"/> height of work surface <input type="checkbox"/> type of seating <input type="checkbox"/> height of seating	Students have 4 out of the 4 choices : <input type="checkbox"/> type of work surface <input type="checkbox"/> height of work surface <input type="checkbox"/> type of seating <input type="checkbox"/> height of seating
Furniture is not moveable , may be bolted to the floor	Some furniture can be moved but is not easily movable by students	Most furniture can be moved, but only some is easily movable by students	All furniture can be moved and most/all is easily movable by students
Furniture is not reconfigurable	Some furniture can be reconfigured but is not easily reconfigured by students	Most furniture can be reconfigured but only some is easily reconfigured by students	All furniture can be reconfigured and most/all is easily reconfigured by students
Furniture is not condensable	Some furniture is condensable but is not easily condensed by students	Most furniture is condensable but only some is easily condensed by students	All furniture is condensable and most/all is easily condensed by students
Teacher space consumes more than 10% of the floor space and is not moveable	Teacher space consumes less than 10% of the floor space and is not easily moveable	Teacher space consumes less than 10% of the floor space, but only some is easily moveable	Teacher space consumes less than 10% of the floor space and most/all is easily moveable
Column total: 0	Column total:	Column total:	Column total:
			TOTAL POINTS

Fig. 3
Flexible Learning Environment Scale for elementary classrooms