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Impact of Flexible and Non-flexible Classroom Environments on Learning of Undergraduate Students*

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Abstract: The physical factors, which were studied less often than the other factors affecting students' learning, were considered in this study. The present study investigated the effect of the flexibility and non-flexibility of the physical classroom setting on undergraduate students' learning. The study adopted a mixed-method research design. The quantitative phase of the study employed the quasi-experimental method of research utilizing the pretest-posttest non-equivalent groups design. T Test and the Repeated Measures ANOVA test was used to compare the group means. In the qualitative phase of the study, the students received a questionnaire with open-ended questions to gather their opinions, and the data were analysed in NVIVO 11. There was no significant difference between the experimental and control groups in terms of learning; however, the achievement scores of both groups were found to be high. Furthermore, the views received from both groups indicated that the physical environment influenced learning in terms of motivation and enthusiasm.

Keywords: Physical classroom environment, flexible classroom setting, learning, undergraduate students, faculty of education.

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Introduction

One of the first areas with a significant impact on student achievement is the physical environment of the classroom. This might be related to several details, such as the structure, resources, and/or colour. All of these can play a role in determining whether the classroom is suitable for learning. Each of them, on their own, may not have a major impact on student achievement; however, they, together, can be effective in strengthening a student's ability to learn (Hannah, 2013) like smaller class size (Nguyen et al., as cited in Ghazali, 2017).

Proper arrangement of the classroom environment plays a significant role in making the education process more effective and creates an atmosphere that encourages learning. The quality of the physical classroom environment significantly affects the academic achievement of students. Physical facilities in classrooms provide an effective and successful teaching and learning process. Without these facilities, it is not possible to have an effective and efficient teaching and learning process. In a well-organized classroom environment, students receive more information from their teachers, and as a result, they perform better. Similarly, if students feel uncomfortable in the classroom, they cannot learn more. Lyons (2001) stated that schools with limited facilities adversely affect teachers' effectiveness and performance, and consequently, student achievement is negatively affected. MacAulay (1990) and Walker and Lambert (1995) found that a well-organized classroom can enhance students' academic and behavioral outcomes. Haertel, Walberg, and Haertel (1981) concluded that students perceive the classroom environment as a principal factor when it comes to student grades, that is to say, achievement, motivation, and satisfaction. They also maintained that success in cognitive and affective learning outcomes was repeatedly associated with a classroom environment that was characterized by commitment, consistency, satisfaction, goal-orientation, organization, and less disagreement (Suleman & Hussain, 2014). The study conducted by Treagust and Wahyudi (2004) revealed a significant difference between the perception of the preferred and actual learning environment and a preference among students for a classroom environment that is more favourable than that which they actually experience. Chan (1988) concluded that humans,

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inherently, feel better when their surroundings are pleasant. Students with better attitudes often learn more and study harder.

Flexible Classroom Setting

Traditional classrooms with fixed seating patterns cause the teaching and learning process to flow in a unidirectional and linear manner. Therefore, many educational institutions are transitioning to flexible and technologically equipped classroom settings with Internet connections (Neill, 2008; Eryilmaz, Adalar & Icinak, 2015). From a pedagogical perspective, learning environments should provide a setting in which teachers and students can explore knowledge together. An effective learning environment should be flexible enough to be designed in accordance with multiple learning approaches such as individual work and reflection, one-to-one instruction, peer-to-peer discussion, small group work, teacher-directed instruction, student presentations, and so on.

Traditional classrooms settings, which have fixed seating arrangements, force teaching and learning to one-way and direct flows. To demonstrate this connection between space and learning, many institutions are experimenting on flexible classroom settings (Classrooms, n.d.). Rydeen (1993) suggested that schools should be flexible enough to support the diversity of changing educational strategies. According to Rydeen, foldable partitions, conference halls for large groups, spaces for small groups, and offices for staff are just a few of the features that should be present in design.

In learning environments with flexible designs, students can be seen studying while lying on the carpet or sitting on low tables, cushions, or beanbags. Students can work alone or in a group. Different activities may take place simultaneously.

Effective use of flexible classroom settings necessitates teachers' environmental competence to be high. Environmental competence requires an awareness of the characteristics of the physical environment and then requires the ability to control or change the environment. Lackney (2008) argued that the lack of environmental competence could lead to teacher-led pedagogies in flexible learning environments. However, understanding the impact of the environment tends to depend on direct experience rather than formal education (Horne-Martin, 2002), and a recent study found that teachers' self-discoveries in a flexible learning environment are highly valuable in building trust (Frith, 2015).

Another important characteristic of flexible learning environments is that they are large enough to conduct various learning activities. This size allows a number of different grouping strategies such as whole class, mixed class, small groups, and individual studies (Gump, 1987) according to type of course (Folkins, Friberg & Cesarini, 2015). Such a class would also be suitable for a student in need of assistance to have one-to-one tuition with the teacher or their peer and not be disturbed by other students in the class (Clark, 2002; McAllister & Hadjri, 2013).

The main aim of this study was to determine the impact of flexible and non-flexible classroom designs, which support various pedagogical approaches and learning experiences, on students' learning. In line with this main purpose, answers to the following questions were sought:

1. Do the pre-test learning scores of the control and experimental groups in the classroom management course differ significantly?
2. Does the pre-test and post-test learning scores of the control group in the classroom management course differ significantly?
3. Does the pre-test and post-test learning scores of the experimental group in the classroom management course differ significantly?
4. Does the post-test learning scores of the control and experimental groups in the classroom management course differ significantly?
5. Do the pre-test, intermediate test and post-test learning scores of the control and experimental groups in the classroom management course differ significantly?
6. What are experimental group's and control group's views about the impact of physical class environment on teaching?
7. What are experimental group's and control group's views about the advantages and disadvantages of flexible class environment?
8. What are experimental group's and control group's views about the effect of physical class environment on learning?
9. What are experimental group's and control group's views about the desire for a flexible classroom?

This study is limited to 2018-2019 fall term and 3rd grade pre-service teachers in the departments of classroom teaching and social sciences teaching.

Methodology

In this part; research design, sample, data collection and analyzing of data are mentioned.

Research Design

A mixed-methods research design was adopted to measure the impact of a flexible and a non-flexible classroom environment on students' learning.

Sample and Data Collection

Quantitative Phase

The quantitative phase of the study adopted a statistical one-group pre-test/post-test design. In this design, measurements of the dependent variable can be obtained from the subjects before implementation (Buyukozturk et al., 2017). One group (pre-service classroom teachers) was determined as the experimental group, and the other (pre-service social sciences teachers) was determined as the control group. Then, a pre-test was administered to measure the knowledge level of the two groups regarding the subjects related to the course (classroom management). The control group received tuition in a traditional classroom setting, while the experimental group was taught in a flexible classroom environment. To control for different variables, both groups were taught in an equivalent manner by the same faculty member (project coordinator) on different days of the week but at the same time of the day. The groups completed a pre-test, intermediate-test, and post-test during the implementation process. Visuals of the flexible classroom and traditional classroom are given below.



Figure 1. Traditional classroom environment



Figure 2. Flexible classroom environment

3rd grade pre-service teachers studying in the classroom teaching department and 3rd grade pre-service teachers studying in the social sciences teaching department at the Mus Alparslan University Faculty of Education constituted the study group in the present study. 18 of the 3rd grade pre-service teachers in the department of classroom teaching at Mus Alparslan University Faculty of Education were females and 9 were males, while 20 of the 3rd grade pre-service teachers in the department of social sciences teaching were females and 15 were males. 23 of the 3rd grade pre-service teachers in the department of classroom teaching were 20-22 age group and 4 of them were 23-25 age group. 30 of the 3rd grade pre-service teachers in the department of social sciences teaching were 19-23 age group and 5 of them were 24-26 age group. The total number of participants in the study was 62.

The study group consisted of students whose grade point averages in the past four semesters until the start of their 3rd year were close to each other's. The grade point average of those studying in the classroom teaching department was 97.33, while those in the department of social sciences teaching had a grade point average of 96.735. In line with this, the students in the classroom teaching and social sciences teaching departments were chosen as the study group for this experimental study.

Pre-test, intermediate-test, and post-test forms were used as data collection tools.

The Pre-test Form: A test with 20 multiple-choice questions was used as the pre-test form. The test's content validity and its accordance with the learning outcomes in the course were ensured. Moreover, all the questions in the test had five options.

Intermediate-test Form (Mid-term Exam): A question form with four open-ended questions was used as the mid-test. The test included questions about measuring students' learning outcomes. The first question addressed the creation of rules in the classroom; the second question addressed discipline in the classroom; the third question addressed reinforcers; and the fourth question addressed the manner in which to approach students with different profiles.

Post-test Form (Final Exam): A test with 20 multiple-choice questions was used as the post-test form. It was ensured that the final exam that was used as the post-test addressed the learning outcomes in the pre-test form. In addition, all the questions in the test had five options.

Item difficulty and discrimination indices of the pre-test and post-test used in the study were calculated.

The data for the study were collected in three stages in an academic year through a multiple-choice pre-test, a conventional exam as the intermediate-test, and a multiple-choice post-test administered to 3rd-grade pre-service teachers in the classroom teaching and social sciences teaching departments. In the fall term; pre-test was executed in the 2nd week, intermediate test was executed in the 8th week and post-test was executed in 15th week.

Qualitative Phase

The qualitative phase of the study adopted a case study design, which provides an in-depth analysis and interpretation of the relationships between cases in the interpretive paradigm (Cohen, Manion & Morrison, 2007). In this sense, in the present study, the case study design was used to conduct an in-depth and detailed investigation of the effect of a flexible classroom environment on learning.

The study group in the qualitative phase of the study consisted of 3rd-grade pre-service teachers in the department of classroom teaching (experimental group) and 3rd grade pre-service teachers in the department of social sciences teaching (control group) at the Mus Alparslan University Faculty of Education. 25 of the 3rd grade pre-service teachers in the department of classroom teaching at the Mus Alparslan University Faculty of Education were females and 8 were males, while 18 of the 3rd grade pre-service teachers in the department of social sciences teaching were females and 14 were males. 28 of the 3rd grade pre-service teachers in the department of classroom teaching were 20-22 age group and 5 of them were 23-25 age group. 28 of the 3rd grade pre-service teachers in the department of social sciences teaching were 19-23 age group and 4 of them were 24-26 age group. Overall, the number of participants was 65.

A questionnaire consisting of nine questions in relation to students' views on flexible classroom environments—three questions on demographic characteristics (department, gender, and grade level) and five open-ended questions—was prepared. The questions were determined after a review of the literature, and two educational administration experts reviewed and finalized the questions.

Open-ended questions were designed to gather students' thoughts and comments about the contribution of the physical classroom environment to teaching; the advantages and disadvantages of a flexible classroom; the contribution of the physical classroom environment to learning; and the desire to design a flexible classroom environment.

The data were collected personally by the researcher in an academic term, in the classroom environment, and in approximately 30 minutes through the open-ended question form distributed to the 3rd grade pre-service teachers in the classroom teaching and social sciences teaching departments.

Analyzing of Data

Quantitative Phase: Independent Samples t-test was used to compare the measurements of learning as the dependent variable for the experimental and control groups. ANCOVA was used to measure the effect of a flexible classroom environment.

Qualitative Phase: The responses of the students to the open-ended questions were transcribed in Microsoft Word, a word processing tool. After transcription, the data were analyzed through content analysis. The purpose of content analysis was to bring together similar data within the scope of certain concepts and themes and to interpret and organize them such that the reader could understand (Yildirim & Simsek, 2013, p. 259). NVIVO 11, a qualitative data analysis software package, was used for content analysis, and all qualitative data were analyzed in 5 days. The participants were given codes such as 4P and 28P, where P stands for participant.

Findings / Results

Quantitative Findings

This section presents the results of the pre-test, mid-test, and post-test forms administered to the experimental and control groups to reveal the effect of the flexible classroom environment on learning at the end of the fall semester during the 2018-2019 academic calendar.

Table 1. Results of Normality Tests of Data Distribution

		Kolmogorov-Smirnov			\bar{X}	Median	Skewness	Kurtosis
		Statistic	df	p				
Pre-test	Social Sciences Teaching	,112	35	,200	56,29	60	-,809	1,115
	Classroom Teaching	,161	27	,072	55,19	55	-,550	0,951
Intermediate test	Social Sciences Teaching	,092	35	,200	79,09	78	-,390	0,038
	Classroom Teaching	,111	27	,200	81,81	83	107	-1,011
Post-test	Social Sciences Teaching	,175	35	,008	80,71	80	-,142	0,071
	Classroom Teaching	,145	27	,148	78,15	75	263	-,025

The Kolmogorov-Smirnov test was conducted to examine the distribution of the dataset as the number of participants was over 50. It was found that the distribution of data was normal except for the post-test scores of the social sciences teaching group ($p > 0.05$). When the other assumptions of the normal distribution (mean-median proximity and kurtosis and skewness values between -1 and +1) were analyzed, it was determined that the post-test scores of the social sciences teaching group also had a normal distribution (Morgan et al., 2004). According to the central limit theorem, a sample volume over 30 indicates that the distribution is closer to normality. Considering this information, the data were determined to be close to normal distribution. We decided to conduct normal distribution analyses for the study.

Table 2. Independent Groups T Test Results Related to Classroom Management Course Pre-Test Scores of Control and Experimental Groups

Group	Measurement	N	\bar{X}	SD	dF	t	p
Control	Pre-test	35	56,29	15,593	60	,301	,764
Experimental		27	55,19	12,285			

Table 2 shows that there was no significant difference between the pre-test learning scores of the control and experimental groups in the classroom management course [$t(60) = 0.301$; $p > 0.05$]. In other words, as the pre-test learning scores of the control and experimental groups were close to each other, it can be argued that these two groups were equivalent. The null hypothesis that stated that there was no difference between the mean scores of the groups was accepted as the p -value was greater than 0.05. Accordingly, no statistically significant difference was found between the pre-test learning means of the groups. In order to identify whether the experimental procedure had any effect, a Dependent Samples t -test was conducted, which determined whether the difference between the pre-test and post-test learning scores of the groups was significant. The results are presented in Table 3, 4 and Table 5:

Table 3. Dependent Groups T Test Results of Control Group Students' Classroom Management Course Pre-Test and Post-Test Learning Scores

Group	Measurement	N	\bar{X}	SD	dF	t	p	Cohen's d
Control	Pre-test	35	56,29	15,593	34	8,888	,000	-1,5
	Post-test	35	80,71	7,290				

A Dependent Samples t -test was conducted to determine whether there was a difference between the mean scores of the exams in a classroom management course administered at the beginning and end of the semester in a class of 35 students wherein the effect of the teaching environment on learning in the course was investigated. The results showed that there was a significant difference between the pre-test scores at the beginning of the semester ($X_{pre-test} = 56.29$) and the post-test scores at the end of the semester ($X_{post-test} = 80.71$) [$t(34) = 8.88$; $p < 0.000$]. The effect size calculated on the basis of the result of the test ($d = -1.5$) indicates that this difference is quite big (Green & Salkind, 2005). This suggests that conducting a course in a traditional classroom environment has a significant effect on students' learning in the course.

Table 4. Dependent Groups T Test Results Related to the Class Management Pre-test and Post-test Learning Scores of Experimental Group Students

Group	Measurement	N	\bar{X}	SD	dF	t	p	Cohen's d
Experimental	Pre-test	27	55,19	12,285	26	9,487	,000	-1,83
	Post-test	27	78,15	9,722				

A Dependent Samples t -test was conducted to determine whether there was a difference between the mean scores of the exams in a classroom management course administered at the beginning and end of the semester in a class of 27

students wherein the effect of the teaching environment on learning in the course was investigated. The results showed that there was a significant difference between the pre-test scores at the beginning of the semester ($X_{pre-test} = 55.19$) and the post-test scores at the end of the semester ($X_{post-test} = 78.15$) [$t(26) = 9.487; p < 0.000$]. The effect size calculated on the basis of the result of the test ($d = -1.83$) indicates that this difference is quite high (Green & Salkind, 2005). This suggests that conducting a course in a flexible classroom environment has a significant effect on students' learning in the course.

Table 5. Independent Groups *t* Test Results Regarding Class Management Post-test Learning Scores

Group	Measurement	N	\bar{X}	SD	dF	t	p	Cohen's d
Control	Post-test	35	80,71	7,290	60	1,188	,239	,304
Experimental		27	78,15	9,722				

As can be seen in Table 5, an Independent Samples *t*-test was conducted to determine whether the teaching environment had a significant effect on learning in a classroom management course. There was no significant difference between the test scores of the students who attended the course in a flexible classroom environment ($X_{experimental} = 78.15$) and the test scores of the students who attended the course in the traditional classroom environment ($X_{control} = 80.71$) [$t(60) = 1,188; p > 0.05$]. This indicates that conducting a course in a flexible classroom environment does not have a significant effect on students' learning in the classroom management course. The effect size calculated on the basis of the result of the test ($d = -304$) shows that this difference is minor (Green & Salkind, 2005). This suggests that conducting a course in a flexible classroom environment does not have a significant effect on students' achievements in the classroom management course.

Table 6. Descriptive Statistics of Flexible Classroom Application Learning Test

Measurements	\bar{X}	Standard Deviation
Pre-test	55,81	14,148
Intermediate test	80,27	9,258
Post-test	79,60	8,459

Table 7. One-way ANOVA Results for Repeated Measures of Classroom Teaching Learning Scores

Source of Variance	Sum of Squares	dF	Average Squares	F	p	η^2
Pre-test	24078,91	2	12039,46	115,05	,000	0,65
Intermediate test						
Post-test						
Error	12766,42	122	104,64			
Total	36845,33	124				

Mauchly's test of sphericity (Sphericity $W(2) = 0.920, p > 0.05$) used to test the assumptions of the analysis showed that the assumptions were met. A repeated measures one-way ANOVA was performed to determine whether there was a significant difference between the learning scores, and a statistically significant difference was found [$F(2,122) = 115.05, p < 0.05$]. According to the calculated effect size (0.65), 65% of the variance can be explained. A Bonferroni multiple comparison test was performed to determine which measurements were significantly different from each other.

Table 8. Bonferroni Test Pairwise Comparisons

(I) MEASURE	(J) MEASURE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
1	2	-24,468	2,037	,000	-29,483	-19,453
	3	-23,790	1,864	,000	-28,378	-19,203
2	1	24,468	2,037	,000	19,453	29,483
	3	,677	1,582	1,000	-3,218	4,573
3	1	23,790	1,864	,000	19,203	28,378
	2	-,677	1,582	1,000	-4,573	3,218

Table 8 presents the result of the Bonferroni test. According to the results, there was a significant difference between the 1st and 2nd measurements and the 1st and 3rd measurements; however, no significant difference was found between the 2nd and 3rd measurements. The results showed that learning improves significantly after practicing in a flexible classroom. The lack of a significant difference between the 2nd and 3rd measurements may be related to the fact that there was not enough time between the mid-test and post-test for a change to occur.

Qualitative Findings

Open-ended questions were asked to the participants to gather their opinions about the effect of the flexible classroom environment on academic achievement at the end of the fall semester of the 2018–2019 academic calendar. This section first presents the qualitative findings obtained from the experimental group consisting of pre-service classroom teachers, and then, the qualitative findings were obtained from the control group consisting of pre-service social sciences teachers.

The qualitative data was content-analyzed in line with the question order to create codes and develop themes. The responses given to the four questions by 65 participants, 33 of whom were pre-service classroom teachers, with the rest being pre-service social sciences teachers, were analyzed separately for each class. The responses from the experimental group yielded 38 codes, while those from the control group yielded 39. The resulting codes for both sets of data (i.e., the experimental and control groups) were grouped under the same themes (see Table 8).

Table 8. Emerging Themes Based on Qualitative Findings and Striking Codes (Experimental Group)

Themes and Striking Codes Based on Qualitative Findings (Experimental Group)	
1) Impact of Physical Class Environment on Teaching	- The effect of class arrangement on learning (N = 10) -The environment encourages learning (N = 10) -Enhance the environment suitable for the activity (N = 8)
2) Advantages and Disadvantages of Flexible Class Environment	- More motivating classroom environment (N = 9) - More suitable for activity (N = 6) -To make the student more active (N = 6)
3) The Effect of Flexible Class Environment on Learning	- Better focus on learning (N = 14) -Quality course opportunity (N = 8) - Permanent learning opportunity (N = 6)
4) The desire for a flexible classroom	-Yes (N = 10) - Yes for entertainment-game based course (N = 5) - Yes for the difference (N = 5)

Table 8 presents the four themes that emerged after the analysis of the data obtained from the experimental group, who were taught throughout a term within the project entitled “Flexible Classroom Free Education”: 1) “the effect of the physical classroom environment on teaching,” 2) “the advantages and disadvantages of the flexible classroom environment,” 3) “the effect of the physical classroom environment on learning,” and 4) “the desire for a flexible classroom.” These themes are presented separately below, including a number of notable quotes from the participants.

The First Theme: The Effect of the Physical Classroom Environment on Teaching

The analysis of the data collected from the participants in the experimental group in relation to the effect of the physical classroom environment on teaching showed that approximately one-third of the participants (N = 10) believed that the layout of the classroom affected teaching (1P, 2P, 3P, 7P, 8P, 13P, 22P, 26P, 30P, 31P); again, approximately one-third of the participants (N = 10) believed that the physical layout of the classroom played a role in promoting learning (4P, 5P, 9P, 15P, 17P, 18P, 21P, 23P, 27P, 29P); and eight participants underlined that the physical characteristics of the classroom are important for implementing activities in a class (9P, 16P, 19P, 20P, 22P, 25P, 28P, 33P). A striking finding was the fact that one of the participants (6P) considered the classroom environment to be bereft of an influence on teaching. Another participant (10P) laid stress on the importance of the teacher rather than the classroom environment for the quality of teaching.

For example, few participants who commented on the effect of the physical conditions in the classroom on teaching and learning pointed out the relationship between the physical environment and permanence in learning and motivation in class.

“Learning is more effective in a learning environment with a more relaxing physical layout. If the physical layout is not satisfactory, permanence in learning may not be achieved. First and foremost, the students should feel relaxed in the classroom environment.” (23P)

“Yes, I think so. No student wants to learn in a poorly-lit, unclean classroom where the desks and chairs are untidy, and it might be more difficult to make students focus on the class.” (26P)

A participant underlined that the physical environment does not affect teaching, arguing that arranging the classroom in a flexible classroom environment leads to loss of time:

"No, I don't think so. It is untidy, and we have to spend the first five to ten minutes arranging the classroom after we enter the class." (6P)

A participant stated that the physical layout has a limited impact on teaching, but the qualities and the competence of the teacher teaching the class play a superior role:

"Somewhat. The quality of the teacher is more important than the environment." (10P)

The Second Theme: The Advantages and Disadvantages of a Flexible Classroom

The analysis of the data collected from the participants in the experimental group, regarding the advantages and disadvantages of a flexible classroom, suggested that nearly one-third of the participants (N = 9; 1P, 8P, 14P, 15P, 17P, 18P, 19P, 24P, 26P) emphasized that the flexible classroom environment is more motivating. Almost one-fifth of the participants (N = 6; 6P, 13P, 20P, 21P, 30P, 33P) stated that the flexible classroom environment is more suitable for activities. Similarly, nearly one-fifth of the participants (N = 6) expressed that the flexible classroom environment made students more active (7P, 12P, 16P, 23P, 25P, 33P), while one participant (17P) pointed out that they had difficulty in arranging the classroom while trying to set up a flexible classroom environment, and another participant (10P) argued that the teaching technique was more important than setting up a flexible classroom environment.

Quotes from participant responses that indicated that the flexible classroom environment is more motivating and desirable than the traditional classroom environment; that students are able to play games more comfortably; and that they move away from the mundaneness of the classroom setting are as follows:

"Traditional classes do not offer any excitement anymore. People want classroom settings that are chirpy and different, where it is more comfortable to listen to the teacher, and where they go willingly in the morning. In short, traditional classrooms have nothing attractive. They do not appeal to people." (1P)

"In a physically enriched classroom, students are able to play comfortably, and teachers are able to teach more effectively. In traditional classroom environments, on the other hand, students have little opportunity to play and the teachers' lectures are not enjoyable." (25P)

It is worth noting that one participant stated that it was difficult to establish an order and change it in a flexible classroom environment:

"A physically enriched classroom is good, but it might create some problems. Like, arranging the desks and chairs at the beginning of the class..." (17P)

Another participant argued that there was no considerable difference between traditional and flexible classroom environments and maintained that what matters is the teaching technique employed in the course:

"I do not see a huge difference. It is the teaching technique that matters." (10P)

The Third Theme: The Effect of the Physical Classroom Environment on Learning

The analysis of the data collected from the participants in the experimental group regarding the effect of the flexible classroom environment on learning indicated that almost half of the participants (N = 14) perceived the flexible classroom environment to be practical and of help to students to better focus on learning (2P, 4P, 6P, 7P, 8P, 9P, 13P, 15P, 18P, 24P, 26P, 28P, 29P, 33P), and one-third of the participants (N = 8) argued that the physical structure of the classroom is quite critical in leading a high-quality class (3P, 12P, 14P, 19P, 21P, 23P, 26P, 31P). Two of the participants (1P, 30P) expressed that they associated the physical classroom environment with teaching through interaction, and one participant (10P) argued that the physical classroom environment played a role in creating a relationship between the teacher and student. Data from two participants (25P and 32P) were not included in the analysis as they were considered to be invalid.

Few participants argued that having an arrangeable classroom structure triggers student concentration, makes the course better serve its goals, and leads to a more effective course:

"When we arrange the classroom, considering the subject we will cover and the activities we will do, teaching becomes more effective. When the physical layout of the classroom is not suitable, students may not focus on the teacher. When we arrange the physical layout of the classroom, we leave nothing that can distract students during a class." (13P)

"I want to explain this through examples. For example, the teacher wants to assign a cooperative task. When they arrange the desks in the cluster model, the classroom becomes a more communicative setting where the interaction among students is powerful. For example, if they have the art class in an art studio, the class becomes more effective and pleasant." (1P)

One participant believed that the physical layout of the classroom had a partial effect on students' learning but that the relationship between the teacher and student had a greater effect on it:

"We can see a partial effect, and what really matters in learning is the teacher-student relationship." (10P).

The Fourth Theme: The Desire for a Flexible Classroom

The analysis of the data from the participants in the experimental group in relation to the desire for a flexible classroom indicated that nearly one-third of the participants (N = 10) wanted to have a flexible classroom although they did not elaborate on it (2P, 3P, 4P, 5P, 11P, 14P, 15P, 18P, 23P, 31P), and five participants (6P, 9P, 22P, 24P, 27P) stated that they had positive feelings about flexible classrooms for entertainment and game-based courses. Three of the participants expressed that they wanted flexible classrooms to teach students from different backgrounds (10P, 21P, 33P), and only one participant (17P) explained that they wanted to have a flexible classroom to keep students active in classes.

Quotations from participants who stated that they wanted to have flexible classrooms and arrange their classrooms; that they wanted to move away from the traditional classroom environment and have flexible classrooms instead; and that a flexible classroom environment could deter students from resorting to rote learning are as follows:

"Yes, the desks and walls will be the same color. There should be cabinets in different shapes instead of rectangular ones. There will be a wish tree. I will put a problem box in the classroom, and the students will be able to write down their questions and put them in the box instead of keeping them to themselves. There are things that I will need to do after reading the notes secretly, and I will do them." (19P)

"Yes, I think so. When I become a teacher, I am thinking of arranging my own classroom myself. I will certainly try to design a classroom that is different from the traditional classroom environment." (20P)

"Yes, because learning in classical ways leads to rote learning. No one knows the content of the information they learn. I am thinking of having a flexible classroom environment to teach to the fullest." (28P)

An excerpt from a participant who believed that they can make the students active in the flexible classroom environment is as follows:

"Yes, I think so. I think it will be good at making students active." (17P)

Table 9. Emerging Themes and Striking Codes Based on Qualitative Findings (Control Group)

Themes and Striking Codes Based on Qualitative Findings (Control Group)	
1) The Contribution of the Physical Classroom Environment to Teaching	-The effect of class size on teaching (N = 9)
	-The contribution of medium to education (N = 7)
	- Contribution of tidy-clean classroom environment (N = 6)
2) The Advantages and Disadvantages of the Flexible Classroom Environment	- Finding more modern materials (N = 10)
	- More efficient learning (N = 10)
	- Equipped with more modern technology (N = 9)
3) The Contribution of the Physical Classroom Environment to Learning,	- Effect on learning motivation (N = 15)
	- Effect on meaningful and permanent learning (N = 14)
	-The presence of contribution to learning (N = 9)
4) The Desire for a Flexible Classroom	- Necessary for effective learning (N = 8)
	-Yes (N = 6)
	- Required for the activity (N = 5)

Table 9 presents the four themes that emerged from the analysis of the data obtained from the open-ended question form given to 3rd-grade pre-service teachers in the department of social sciences teaching, who were taught throughout a term within the project entitled "Flexible Classroom Free Education": "the contribution of the physical classroom environment to teaching," "the advantages and disadvantages of the flexible classroom environment," "the contribution of the physical classroom environment to learning," and "the desire for a flexible classroom." These themes are presented separately below, including a number of notable quotations from the participants.

The First Theme: The Effect of the Physical Classroom Environment on Teaching

The analysis of the data regarding the effect of the physical classroom environment obtained from the participants in the experimental group showed that almost one-third of the participants (N = 9) considered the size of the classroom as affecting teaching (3P, 5P, 13P, 15P, 18P, 19P, 21P, 26P, 28P); seven participants stated the physical environment affected teaching (6P, 9P, 12P, 16P, 23P, 25P, 29P); and six participants pointed out that a clean and regular classroom environment played a role in the quality of teaching (4P, 10P, 17P, 26P, 30P, 31P). A striking finding worth noting was the fact that three participants believed the color of classroom walls to affect teaching (13P, 22P, 24P).

A number of participants who considered the flexible classroom environment to be useful in terms of students' spiritual relaxation and attention to the course and who mentioned that the traditional classroom layout did not allow group work and activities made the following statements:

"I think that it certainly has a contribution. Students are affected by the environment in the classroom; a tidy environment that is more fun and more comfortable helps students to concentrate and feel comfortable in the class. Physical conditions help students to be more comfortable both visually and psychologically." (31P)

"Yes, it certainly has effects. In short, I think that the desks and chairs in the classroom have an effect. The desks in the classroom were fixed. This puts more emphasis on the individual factor. This problem prevents the organization of group work or activities even at a very small scale." (8P)

One of the three participants who emphasized that the color of the walls played a key role in teaching and learning within the physical environment of the classroom stated the following:

"Yes, the classroom environment should be organized. It should be painted in a light tone, the desks should be arranged such that they are suitable for the students to be able to follow the course, and the materials should have an order." (24P)

The Second Theme: The Advantages and Disadvantages of a Flexible Classroom

The analysis of the data on the advantages and disadvantages of a flexible classroom obtained from the participants in the experimental group suggested that nearly one-third (N = 10) of the participants perceived flexible classrooms to be equipped with modern materials (4P, 5P, 9P, 12P, 17P, 18P, 19P, 20P, 26P, 31P); nine of the participants stated that flexible classes had modern technology (4P, 5P, 8P, 14P, 15P, 18P, 19P, 26P, 31P); two participants mentioned that it provides flexibility to the teacher in terms of arranging the classroom layout (13P, 22P); and three participants believed that it increased students' interest and motivation (6P, 7P, 11P).

Quotations from participants who believed that flexible classrooms also meant rich and modern classrooms, that such an environment ensured efficiency in learning and teaching, that the traditional classroom environment was boring for students, and that students were more active in the modern classroom are as follows:

"A traditional classroom consists of a board and desks facing the board. I think that a classroom with an enriched physical environment (modern) will ensure higher efficiency for students and teachers. This is because such classroom environments are equipped with the latest technological facilities such as projectors, smart boards, Internet connections, and so on." (8P)

"There are differences between the classrooms with a physically enriched environment and traditional classrooms. While there are technological devices and advancements such as smart boards, projectors, and the Internet in an enriched classroom environment, these are not available in the traditional classroom environment. In the traditional classroom environment, there are tools such as blackboards and overhead projectors that affect how the course is taught." (14P)

"As the traditional classroom environment does not provide many opportunities for students, they get bored. Direct instruction is dominant. In a classroom where the physical environment is enriched, students do not have the time to get bored; everything attracts their attention and interest. Concentration becomes easier." (6P)

"In the traditional classroom environment, there are only desks and smart boards. In the enriched classroom environment, there are projectors, smart boards, and lecterns. This means that students can present themselves better on the board. This helps them. The course becomes active." (18P)

The Third Theme: The Effect of the Physical Classroom Environment on Learning

The analysis of the data regarding the effect of the physical classroom environment on learning obtained from the participants in the control group showed that almost half of the participants (N = 15) perceived the physical structure of the classroom to have an effect on the motivation to learn (3P, 5P, 6P, 8P, 9P, 14P, 17P, 18P, 19P, 19P, 23P, 24P, 26P, 27P, 31P, 32P); almost half of the participants (N = 14) considered meaningful and permanent learning to be associated with the physical structure of the classroom (1P, 3P, 5P, 11P, 12P, 13P, 14P, 15P, 17P, 21P, 23P, 26P, 28P, 30P); one participant (13P) stated that the physical structure of the class had an impact on the creativity of the student; one other participant (10P) expressed that it had an impact on students' achievement in the class; and still another participant (2P) underlined that the physical structure of the class could lead to latent learning.

Quotations from the participants who argued that a flexible classroom environment encourages students' active participation in the course and ensures permanent learning, that disciplinary problems can be mitigated with an appropriate physical environment, that such environments help students become active in course and have a good psychology, and that the physical classroom environment has an impact on learning in terms of helping students to concentrate are as follows:

"Our aim is to ensure students' participation in the course and achieving permanent learning. For this, we must arrange the physical environment accordingly. For example, we cannot expect meaningful learning to occur in a place where the class is small, the number of students is high, and 4–5 students sit at the same desk. This will inevitably lead to unwanted behaviors, which will affect learning." (1P)

"Think of the classroom as an overcast, stuffy, and dark environment. It causes the students to get bored psychologically and feel sleepy. It also causes the student not to pay attention to the course. A classroom that is too hot or too cold also affects it. In an airier classroom with the sun chirping inside, people enjoy studying and they focus on the course." (31P)

One participant highlighted that students' creative skills will increase thanks to the different activities that can be conducted in the physical classroom environment:

"When students learn faster, they become knowledgeable and cultured. Since this environment allows different kinds of activities, students develop creativity." (13P)

One of the participants noted that there is a close and direct relationship between student achievement and the physical environment:

"Students are shaped by their environment, so it is inevitable that students will be successful in an environment that positively affects them." (10P)

Another participant argued that the physical environment in which the student is studying and the visuals, materials, and so on present in the environment will make a difference for students in terms of learning, and this will be reflected positively as latent learning:

"Assuming students' physical environment, that is, the interior of the class is richer, the visuals and materials will appeal to their eye even when they turn their head. So, these messages have inevitably been transferred to students' sub-consciousness. This causes students to learn without realizing." (2P)

The Fourth Theme: Desire for a Flexible Classroom

The analysis of the data related to the desire for a flexible classroom obtained from the participants in the experimental group showed that a quarter of the participants (N = 8) approached the flexible class positively for effective and efficient learning (2P, 3P, 4P, 17P, 20P, 22P, 28P, 29P); six participants stated that they wanted a flexible classroom enriched in terms of materials and technology (1P, 6P, 8P, 13P, 15P, 25P); one participant (4P) believed that a flexible classroom was necessary to build students' self-confidence; and one other participant (10P) stated that a flexible classroom was necessary for an up-to-date education system.

Quotations from participants who expressed that they wanted to have a flexible classroom environment to avoid direct instruction and enable a better understanding of the subject and supported the creation of different classrooms settings in line with the aim of a course to allow permanent learning and learning by doing are presented below:

"Yes, I think so. I do not want direct instruction; I want to reinforce the subject that I am teaching, and for this, materials and activities are a must. I want to design what I need for an activity based on the ideas I get from the students." (3P)

"I think a teacher should teach in different classes. For example, a separate classroom should be arranged for activities. Another classroom should be created for the normal course. This will create a more attractive learning space for students." (16P)

"Yes, I think it will enable students to learn in history and geography classes when they enter this classroom by experiencing the course and being connected to the atmosphere in this environment." (22P)

One of the participants wanted a flexible classroom environment for students to allow them to be more comfortable in expressing themselves:

"We need to create an environment for students to express themselves better." (4P)

One of the participants argued that they wanted a flexible classroom as a class that can be arranged in various ways can attract more students into the learning process:

"I want it because flexibility is wealth, and who does not want to teach in a rich environment?" The more flexible the class, the more I can appeal to different students." (26P)

One participant emphasized that they wanted to have a flexible class as part of changing, developing, and up-to-date education systems within the context of the globalizing world:

"Yes, this is necessary anyway because we need to keep up with the changing education system." (10P)

Conclusion

From a pedagogical perspective, educators need to reassess the school and classroom spaces. In this study, one of the large classrooms in the Faculty of Education (FQT101) has been arranged such that it allows for the application of different teaching methods and techniques after being freed from a fixed order. The most important contribution of such a classroom environment is that it supports pedagogical approaches and learning experiences. Environmental psychologists acknowledge that physical spaces can affect behavior both positively and negatively (Mehrabian & Russell, 1974). This study was aimed at examining how flexible classroom space enhances students' interest in the course, collaboration, flexibility, and learning. Flexible desks, furniture, portable panels, and foldable partitions—all of which allow the arrangement of courses in line with teaching and learning objectives—were prepared to create a flexible space in the Faculty of Education that was suitable for various teaching strategies and methods. In line with this, the aim of the project was to create a flexible classroom environment by equipping the class with single seats and foldable tables, portable panels to display announcements and student work, and carpets and cushions to perform activities on the floor. Thus, the aim was to measure the effect of such an environment on students' learning, understand students' perceptions of such environments, and make flexible classes more common.

Quantitative results showed that there was no significant difference between the mean post-test scores of the experimental and control groups when modified according to the pre-tests scores [$F(1,59) = 1.298, p > 0.05$]. In other words, the impact of a flexible classroom environment on students' learning was not observed. A Repeated Measures one-way ANOVA was performed to determine whether there was a significant difference between the learning levels of students, and a statistically significant difference was found on the basis of the scores they received [$F(2,122) = 115.05, p < 0.05$]. According to the calculated effect size (0.65), 65% of the difference can be explained. A Bonferroni multiple comparison test was used to determine the measurements that were significantly different from each other. According to the results, there was a significant difference between the 1st and 2nd measurements and the 1st and 3rd measurements; however, no significant difference was found between the 2nd and 3rd measurements. The results showed that learning improves significantly after the implementation of a flexible classroom. The lack of a significant difference between the 2nd and 3rd measurements may be related to fact that there was not enough time between the mid-test and post-test for a change to occur.

According to the qualitative findings of the study, the content analysis of the responses of 3rd-grade pre-service teachers in the department of classroom teaching, who constituted the experimental group, led to the five themes: "the effect of the physical classroom environment on teaching," "the advantages and disadvantages of the physical classroom environment," "the effect of the physical classroom environment on learning," "the idealized classroom environment," and "the desire for a flexible classroom." In line with this, the data that were most frequently coded under the themes included the following: students were observed to perceive that the classroom layout is effective in learning and encourages learning ($N = 20$); that flexible classrooms are motivating ($N = 9$); that they are suitable for activities ($N = 6$); that students are better focused on learning in flexible classrooms ($N = 14$); that flexible classrooms offer higher quality in instruction ($N = 8$); and that they dream of a classroom environment that is enriched with materials ($N = 15$) and suitable for activities ($N = 10$). They generally responded by saying "yes" to the question as to whether they wanted a flexible classroom ($N = 31$). On the other hand, five other themes were developed when the responses of the control group, those studying in the social sciences teaching department, were examined. These were as follows: "the contribution of the physical classroom environment to teaching," "the advantages and disadvantages of flexible classrooms," "the contribution of the physical classroom environment to learning," "the idealized classroom order," and "the desire for a flexible classroom." Accordingly, the data determined to be most frequently coded under the themes based on the students' responses included the following: the students were observed to perceive that class size affects teaching ($N = 9$); that the environment contributes to teaching ($N = 7$); that more modern materials need to be present ($N = 10$); that the physical environment has an effect on the motivation to learn ($N = 15$); that the physical environment has an effect on meaningful and permanent learning ($N = 14$); that they usually dream of a clean, large, spacious, and quiet class ($N = 17$); and that they say "Yes" ($N = 39$) to flexible classrooms.

In conclusion, the quantitative results of the study showed that the physical environment of the classroom did not directly affect the learning of university students, but the qualitative findings of the study suggested that the physical environment was highly effective with regard to learning, high-quality education, permanent learning, and increasing students' motivation to learn.

Discussion

It was observed that the test scores of both groups, students studying in the flexible classroom environment and those taking courses in the non-flexible classroom environment, increased. Consequently, it can be argued that the course and the methods applied were effective for both the control and experimental groups; however, the effect of the physical

environment on test scores was not observed as there was no significant difference between the test scores of the students. Although the results indicate that the physical environment has no direct effect on students' success in the course, it is possible to argue that the physical environments might have had a number of indirect effects on students' learning. In fact, similar results were obtained in a number of earlier studies. For example, Rutter (1979) did not find a relationship between physical factors and learning and student behaviors. Stricherz (2000), likewise, stated that student achievement decreased in old and bad schools; however, he added that it was not possible to solve this problem by simply improving the physical environment. Nevertheless, although there is an uncertain, low, or indefinite effect of the physical environment on learning, there are also studies arguing that it is important to sustain students' morale (Young, Green, Roehrich-Patrick, Joseph & Gibson, 2003; Moore & Lackney, 1993). Schneider (2002), on the other hand, argued that unfavorable learning environments, rather than having directly or indirectly observable effects, caused students' performance to decrease.

In general, the classroom environment plays a significant role in ensuring students' participation and success in the classroom. To this end, the teacher can change the physical environment of the classroom. For example, they can arrange tables in various ways and decorate walls with various assignments or materials. Students can also help the teacher and contribute to this process. Many factors can be controlled by the teacher, including the lighting, ventilation, and even the heating of the classroom. A good teacher is aware that physical factors play a role in student achievement. Teachers prepare their students for failure if they do not pay attention to the classroom environment and organization (Hannah, 2013).

Earlier studies revealed that the physical environment significantly affects students' psychology and social behavior (Moos & Trickett, 1987) and thus their learning (Strange & Banning, 2001). On the other hand, a learning environment equipped with high-quality physical elements can affect the comfort levels during teaching and learning. Therefore, the comfort levels of teaching and learning are reflected in the equipment present in the learning environment; in other words, the furniture and equipment in the environment should be comfortable and satisfying for students. Such comfort in the learning environment can be a factor contributing to the success or failure of students (Puteh, et.al, 2015).

Although no remarkable effect was observed in the quantitative results of the study, the qualitative findings of the study revealed that the physical environment is highly effective in learning. In general, it was concluded that if students felt comfortable in the classroom, they would concentrate on the course taught to them and therefore be able to learn more from their teachers. This would result in higher scores. In fact, Kekare (2015) and Korir and Kipkemboi (2014) found a positive relationship between classroom environment and academic achievement. The relationship between academic achievement and spiritual well-being was also found in a number of studies (Gilayand, 2016; Gilavand, Espidkar, Fakhri, 2015). On the other hand, Haertel, Walberg, and Haertel (1981), in their study, concluded that students perceive the classroom environment to be a key factor for their grades, in other words, their achievement, motivation, and satisfaction. They also maintained that success in cognitive and affective learning outcomes was repeatedly associated with a classroom environment characterized by commitment, consistency, satisfaction, goal-orientation, organization, and less disagreement (Suleman & Hussain, 2014). A study by Treagust and Wahyudi (2004) revealed that there is a significant difference between the perception of the preferred and actual learning environments and that students tend to prefer a classroom environment that is more favorable than they actually experience. Chan (1988) concluded that humans, by nature, feel better when their surroundings are pleasant. Students with better attitudes often learn more and study harder.

Suggestions

On the basis of the findings and results, the researchers make the following suggestions:

- As the qualitative findings of the study indicated that the physical layout of the classroom plays an extremely critical role in reinforcing students' learning, the physical characteristics of classrooms should be well-structured, and offering physical facilities must be a priority at universities. For this aim, it is recommended to increase the cash transfer to the education faculties of universities for rearranging the physical environment of classrooms.
- All classrooms should be furnished by enriched materials; they should be decorated with maps, charts, posters, and wall paintings as they enhance students' interest, attention, and motivation levels. The classrooms should also have portable fabric boards and pin boards to enable students to display their homework and projects.
- It is imperative that all classrooms in education faculties be reorganized with flexible furniture. This is because, from a pedagogical perspective, the physical environment should be designed to accord with the courses taught in education faculties. The classrooms should be equipped with portable and adjustable desks and chairs to allow various activities.

- The classrooms should be designed such that they ease the use of various technologies effectively. The classrooms should have various materials and stationery, and a cabinet should be present in each classroom for these materials.
- It is recommended that a similar study be conducted in high-schools, elementary schools, and primary schools in different cities or for different courses.
- This study can be supported by survey and questionnaire studies with a wider group of participants.
- One of the notable recommendations in this study is that the buildings of education faculties be equipped with flexible furniture and classrooms large enough to offer space for activities such as drama, group work, individual work, games, etc. so that various teaching activities can be undertaken and various courses can be taught in the newly designed classrooms.

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