

Evaluation of learning environment variables in Turkey from the aspect of a learner's health and education

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Abstract

In this study, the learning environment variables from the aspect of a learner's health and education are examined. For this purpose, measurements were taken from a random school in a province of Elazig and the results of these variables were compared for compatibility to literature on the subject. Humidity, temperature, light and noise measurements was performed by a DT 8820 Environment Meter, Oxygen, carbon dioxide, carbon monoxide was performed by a PN 66094 GMI and the magnetic field was measured with a SPECTRA AARONIA AG device. It was observed that based on the measurements of variables that the possibility of health problems arising in some of the learning environment could occur. The obtained measurements were to experience health problems due to variables in the learning environment in some classes.

Keywords: Learning environment; Learner's health; Air quality in the classroom; Physical variables
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1. Introduction

Taking into account Individual differences and current trends in a variety of elective courses, consisting of training programs and professional disciplines, also taking into account that students learn in different ways gives us an idea how to educate students. Our research adds a new dimension to this with this each passing day. One of these dimensions is the learning environment. The learning environment cannot be expressed as a single space now. Depending on the nature of the course, we need to accept the fact that studios, laboratories and even libraries can be considered a classroom.

These spaces will be expressed as learning environments, such as the effects of these environments on learning, and what variables to pay attention to while teaching in these learning environment are things to think about as educators before instruction begins. Learners do not have a voice during the construction of educational institutions. When seeing learning environment variables effect educational success when starting teaching activities or seeing discomfort in educational environments related to certain physiological and psychological is already too late for many things. The point we

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need to concentrate our attention on is not building new classrooms or schools, but keeping in mind the children who run in the schoolyard and have security issues, can be taught but easily tired, and whose concentration can be easily broken when repeatedly reviewing our plans.

2. Conceptual framework

We can classify variables in the learning environment as physical and learning environment variables. We can accept physical variables as objects that we can directly observe such as classroom size, shape and dimensions of doors and windows as well apparent variables being the amount of oxygen, noise, and temperature. Both of these variables have become one of the elements to be considered on the effects on academic activities in group learning. Since a school can be defined as a special environment for the purpose of education [1] and the school's physical properties will affect the student-teacher and student-student communication [2-3], and therefore is thought to possibly inhibiting learning [4-5]. Knowing the learning environment variables and effects is important from the standpoint of protecting student's health and in the productivity of carrying out educational activities.

2.1. Physical dimensions

A classrooms size, format, tools, and seating arrangements should recognize the requirement of teacher and student interaction [6]. A classroom with large or long dimensions prevents the students and teacher from making eye contact with one another [7-8]. Also uncomfortable and inadequate classroom desks cause students to shift attention from the learning material and the teacher [9]. A set of standards from various sources regarding physical measurements for classrooms has been determined. A ceiling height of 3 meters for the classrooms, the window area not to be lower than 18 % of the floor area of the classroom and student-per-use planning area recommendation of 1.2 square meters [10]. If the classroom ceiling height is below this ratio, then a contingency plan of 4 square meters volume per student should be planned [11]. For classrooms with 20 or less students, the Ministry of Education Standards Special Education Institutions Directive dictates that door measurement be 80 cm. and for classrooms that have more than 20 should have a door measurement of 90 cm [12]. In the previous standards directive a distance of 1.70 meters between the blackboard and front row desks was specified.

2.2. Illumination

In particular with the construction of school buildings planning for the effects of daylight on the building, school-class location, the window size and light reflection and glare conditions factor in great significance in the planning [13]. Because if classroom illumination is inadequate then students will be quickly fatigued, and natural lighting will positively affect student emotion, behavior and learning [6]. Sunlight is in the forefront of research regarding classroom illumination. Barker [14] emphasized the need for using natural illumination (sunlight) methods for classroom illumination, and he recommended indirect versus direct lighting. Sunlight increased student performance [15].

2.3. Color

The color selection of a classroom can lead to a monotonous and depressing atmosphere as well as positive feelings being developed toward the learning environment [16]. A learning environment whose colors are well planned can give the individual a sense of security and reduce the level of stress [17]. According to Basar [5] respiration, blood pressure and muscle activity can change according to color. A light blue color creates a relaxing and soothing effect, Dark blue a warning, red an exciting and tension creator and light yellow and orange color has a stimulating effect. Primary education should have warm colors (yellow, pink, etc.); blue and green hues should be preferred in secondary education [14]. In addition, the color green is thought to increase creativity [18]. However, when the color green is looked at over a long period of time, some cells within the eyes are disabled interfering with other colors in short-term perception was determined [19].

2. 4. *Temperature*

Extreme hot and cold in the learning environment effected student concentration toward the classroom work negatively [20]. Unal and Ada [21] indicated that an ideal temperature between 19 degrees and 21.5 degrees in the class, that anything below 23 degrees ambient temperature would affect mathematical and reading skills and also that anything above 26 degrees would warrant unwanted behavior and that work productivity would drop was claimed [6, 22, 23]. High temperatures in the learning environment led to physical discomfort, dissolution of interest and low temperatures led to not focusing on learning [24].

For a person that is properly dressed it can be said that the ambient temperature needed should be around 20 degrees [5]. Barker [14] stated that evaluation of ambient temperature should take into account humidity and physical conditions.

2. 5. *Noise*

One of the variables in the learning environment is noise. Basar [5] mentioned that noise would disrupt physical and mental health that noise led to repetitive educational instruction and must be used effectively during instructional time. Shannon and Weaver cited by Dokmen [25], classified noise as physical, neuro-physical and psychological. According to this classification speech, vision and hearing disorders are defined as noise. Koszarny [26] thought that noise was a reason for the decrease in concentration and attention, and a decrease in children's intelligence and increase in their anxiety level. Another negative finding was obtained by Crandell and Smaldino [27] that ambient noise was found to reduce the sensitivity of hearing in children. Green and others [28] found a correlation between reading skills and ambient noise, and when ambient noise increased a decline in reading skills was determined. Briaucourt cited by Polat and Kirikkaya [4] expressed that noise between 0-35 dB was not harmful, such as noise between 36-65 dB would disrupt sleep and rest and noise above 66 dB would lead to severe mental health disturbance and hearing damage. Walker [29] stated environmental sources such as airports, streets with heavy traffic increased the noise level considerably.

2. 6. *Number of students*

The number of students is another learning environment variable that has been associated with noise and also been dealt with in many other situations. It is difficult to give precise criteria for the number of students in a learning environment. The size of the learning environment, the type of learning activities, and a series of situations such as the group's age level receiving instruction and teaching method should be taken into consideration. Basar [5] Indicated with the thought that younger age groups who need a teacher more would require a relatively smaller number of students in the classroom. Some research findings concluded that classes fewer than 16 people be considered small, 16-25 student's average and higher number of students than 25 is considered large [30, 31]. The Florida Department of Education introduced a limit on the number of students in a classroom that up to the 3rd grade that there would only be 18 students, 22 students between 4th and 8th grade and 25 students between 9th and 12th grade was decided on [32].

2. 7. *Air quality*

Both solid and liquid particles are found together in the atmosphere. The largest of these particles is the size of a grain of sand. The air moves particles resulting from incomplete combustion of fuel, pollen, grains, mold, bacteria, spores, viruses, and animal hairs (skin flakes) [33]. Therefore, breathing clean air is very important, especially for children. A source of air problems in schools can be shown as being chemical pollutants, dust particles, biological contaminants (bacteria, fungi and viruses) [34]. In addition high humidity, lack of oxygen and carbon dioxide can negatively affect air quality in classrooms. It is known that a lack of oxygen leads to students not paying attention and causing drowsiness [20]. Examples that can be shown of other diseases caused by indoor air problems are nose bleeds, coughing, breathing difficulties, fever, chills and muscle aches.

It should be taken into account that in an environment where the air quality is poor that the potential for the airborne transmission of bacteria and viruses will increase. Fresh air requirements in the classroom per individual are 8 L / h [34]. It is known that breathing and metabolic rates are higher in children in the lower age group than adults, so it can be expected that classroom air will become polluted much more quickly [15]. Therefore, where external air is clean fresh air requirements can be met by opening windows. In other cases, air filtering systems should clean the outside air for the learning environment [35].

2. 7. Humidity

In the learning environment, humidity is another variable known to impact learning. The humidity rate in the air affects classroom activities and behaviors [36]. Protection against allergens where ambient humidity has an effect is especially important for the lower age group of students [38]. Health in terms of a learner's environment should be between 30-50% humidity [10]. According to Ilhan and Aygun [38] this ratio should be between 30% and 70%.

2. 7. Electromagnetic field

Electromagnetic field is a term used to indicate the presence of electromagnetic energy in a particular place. There are two components of electromagnetic fields, electric fields in stress intensity per meter (V/m) and the measured magnetic field measurement unit Tesla [39]. For sensitive locations (locations used as permanent residential places, children's play areas, etc.) the magnetic field boundary value is 10 mG (1 μ T) for voltage overhead lines and underground cables and substations greater than 1000 V [40]. Due to power transmission lines carrying high voltages and currents this constitutes low frequency (ELF) electromagnetic fields in the environment. In addition, some of the technological tools in the classroom and student cell phones should be evaluated within this context. The World Health Organization has categorized ELF magnetic fields as potential carcinogens. As a result of non-ionizing electromagnetic waves under the influence of the environment two types of effect may occur in living organisms: thermal effects and non-thermal effects. Thermal effects are defined as electromagnetic energy that is absorbed by the body into heat and causes the body temperature to increase. Non-thermal effects of RF waves are alleged to affect certain disorder and diseases such as changes in brain activity, sleep disorders, attention disorders, and headaches [41]. Building electrical installations electrical field values are 1-10 (V/m) and the value of the magnetic field is accepted to be between 1-5 mG [39].

3. Methods

The research was based on the scanning model. The Scanning model takes a topic of research, an event, person or object in its own terms and tries to define it [42]. Scanning type research examines the relationship between measured variables. These research studies also planned to define the relationships between the properties of the populations [43]. Measurements were made based on the research model of the selected sample during the first and second weeks of April of 2011. Measurements were taken during instructional time in the classroom with students. Humidity, Temperature, illumination and noise was measured by Environment Meter-DT 8820, oxygen, carbon dioxide, carbon monoxide was measured with the GMI PN 66094 device and the magnetic field was measured with the AARONIA AG SPECTRAN device. Temperature measurements were taken from three different points respectively at the heel, heart and head levels. Oxygen and carbon dioxide measurements were measured according to the maximum and minimum values.

3. 1. Populations and samples

The population that was used in the study was the Ministry of National Education Elementary Schools in the province of Elazig. For sampling five schools were randomly selected. Two classes were selected from these schools for a total of ten classrooms in which measurements were taken.

4. Results and comments

This section transfers the findings of the research for discussion. This section is handled

with four sub-headings. The first section deals with classroom illumination, temperature, oxygen, carbon dioxide, moisture and noise measurement. The second section deals with magnetic fields measurements. The third section deals with paint color and types of color in the classroom. In the last section some measurements of physical dimensions are discussed.

4. 1. *Classroom illumination, temperature, oxygen, carbon dioxide, moisture and noise measurement values*

Some of the research that has been conducted has determined that classroom illumination, temperature, oxygen, carbon dioxide, humidity and noise values effects learning and student’s health. Therefore, the level of values for these variables was researched and has been found in the classrooms. The results obtained are given in Table 1.

Table 1. Classroom illumination, temperature, oxygen, carbon dioxide, moisture and noise measurement values

School	Class	Studying in Class	Illumination (Lux)	Temperature (°C) (heel/heart/head)	O ₂ (max/min)	CO ₂	CO	moisture	Noise (dB)
A	A1	5 th grade	132.1	22.4 / 22.5 / 23	20.9-20.5	0.15	0	62.7	59.2
	A2	7 th grade	95	24.7 / 25 / 24.7	20.9-20.7	0.05	0	53	66.23
B	B1	4 th grade	163.3	19.8 / 19.9 / 20	20.9-20.7	0.10	0	50.1	63.53
	B2	1 th grade	138.5	23 / 23.1 / 23.2	20.9-20.6	0.05	0	51.1	70.40
C	C1	4 th grade	88.4	26 / 25.7 / 26	20.9-20.7	0.05	0	50.8	65.53
	C2	4 th grade	375	25.1 / 25.1 / 25.1	20.9-20.7	0.05	0	39.5	76.56
D	D1	2 th grade	236	25 / 25.1 / 25	20.9-20.7	0.05	0	43.1	76.36
	D2	2 th grade	400	24.7 / 24.7 / 24.7	20.9-20.9	0	0	35.6	77.83
E	E1	1 th grade	246	25.1 / 25 / 25.1	20.9-20.5	0.15	0	56.1	71.16
	E2	1 th grade	196	25.1 / 25 / 25.1	20.9-20.7	0	0	47.4	66.4

According to Ministry of National Education Directive for Special Educational Institutions illumination ratios are required to be 100 Lux for pre-schools, elementary school first level (grades 1-5) classrooms 200 lux, elementary school second level (grades 6-8) and middle school classrooms need to be 250 lux [11]. Accordingly, the students studying in the A1, A2, B1, B2, C1 classrooms and in these classes they were expected to tire early and lose attention due to inadequate lighting and the students who were in classrooms C2, D1, D2, E1, which had a high level of glaring lighting in the classes and due to different levels of lighting the students complained of headaches and eye problems. High quality illumination does not mean that there is a high illumination level [44].

Unal and Ada [21] expressed that an ideal classroom temperature would be between 19 degrees and 21.5 degrees respectively. In addition, an ambient temperature environment below twenty-three degrees adversely affected math and reading skills and anything above 26 degrees that the possibility of unwanted behavior would occur and that working productivity would decrease was proposed [6]. Accordingly, only the temperature value in the B1 classroom was within normal limits. The C1 numbered class had the highest temperature value of any classroom. It can be expected that in this classroom that the students may lose interest in the class lesson. Celep [24] in his study indicated that high temperatures in the learning environment can lead to physical discomfort and lead to a loss of interest.

Atmospheric air contains 21% oxygen [45]. A lack of oxygen negatively affects brain functions. When examining the oxygen measurement values in the classrooms with all the values being below 21 %, whereas a substantial decrease in terms of the amount of oxygen in the classroom can be said to have happened. As Karaçalı mentions [20] that if a ventilation activity is not addressed in these classrooms as the class’s progress, the scarcity of the oxygen will be a distraction for the students and signs of drowsiness can expect to be seen.

Normally atmospheric air contains 21% O₂ and 0,033% CO₂ [30]. The composition of the

air that is inhaled in is converted to 16-17% O_2 and 4% CO_2 when exhaled. When this situation is compared to the classroom measurements, it can be seen that carbon Dioxide amounts have increased. The amount of carbon dioxide that was measured in the D2 and E2 classrooms was low. High amounts of carbon dioxide in the environment can lead to discomforts such as heart disease, chest pain, visual disturbances, headache, dizziness, imbalance and nausea.

Different opinions had been raised about the amount of moisture in an ideal environment. Kucukoglu and Ozerbas [10] discuss the learning environment in terms of health should be about between 30-50% humidity, and according to Ilhan and Aygun [38]; this ratio should be between 30% and 70%. It is recommended that in a 20 degree ambient environment that the humidity level be 50 % for light manual work [46]. As the effort spent on a job increases with the moisture level staying constant the ambient temperature should be decreased. According to these measurements only the A1 class should have a humidity level situation that requires attention. In addition, the relationship between the period the measurement values were obtained (April) should be taken into account.

Ambient noise in a learning environment is another situation that needs to be considered. The noise limit can be considered to start at when people have difficulty understanding speech in a quiet environment at 1.5 meters this corresponds to 25 dB [47]. Polat and Kirikkaya [4] pointed out in their research that noise at 36 dB and above may be harmful. The severity of noise is as important as is the exposure of the noise. Most human exposure to noise above 85dB can cause significant hearing loss. For unprotected ears, the average noise level of the permitted duration of exposure should be reduced by half for every 5dB increase [48]. Upon examining the noise measurements taken there is a need to reduce noise in classrooms D2, D1 and C2. In general examination the A1 classroom appeared to be the most problematic per student space and the most crowded class, although the noise value was the lowest out of all the classes despite it being the most populous class. The amount of Carbon Monoxide in this classroom was also found to be high. In addition this classroom had a high humidity level. This increase in the humidity level can be interpreted to its connection to respiration. The Low noise level can also be attributed to measures taken by the teacher in the classroom.

4. 2. Magnetic field measurements in the classroom

In recent years, some student health problems are seen due to frequent use of technological tools. In addition, not taking account the distances during the construction of schools from high power fields and GSM base stations and are being built near areas of resident in an uncontrolled manner is known. With this awareness measurement of magnetic fields at schools was considered. The magnetic field measurements that were obtained are seen in Table 2.

Table 2. Measured magnetic field values

School	Class	Studying in Class	magnetic field measurements	
			Socket	Environment
A	A1	5 th grade	8	0.8
	A2	7 th grade	4	0
B	B1	4 th grade	0.7	1.5
	B2	1 th grade	5.7	1.2
C	C1	4 th grade	2	1.3
	C2	4 th grade	2.3	1
D	D1	2 th grade	2.4	1.5
	D2	2 th grade	0.2	0.2
E	E1	1 th grade	0.8	0.8
	E2	1 th grade	0.7	1.1

An electric field value of 1-10 (V / m) was indicated for electrical installations in buildings, while the value of the magnetic field was noted in the previous section as being between 1-5 mG as an acceptable range. When limit values are examined in the measurements obtained it can be said that apart from the A1 classroom magnetic field limit values were not exceeded. In contrast, it should not be interpreted as low magnetic field values as not having an effect, work should occur in reducing the existing values. Research conducted in the United States and Finland in 1994, put forth that Alzheimer's disease in workers exposed to electromagnetic fields was seen in men 4.9 times and in woman 3.4 times more often than in normal people [39].

4. 3. Measurements aimed at paint color and types of color in the classroom

One of the goals of the study is to determine colors impact on learning and its effect on human metabolism and based on this measuring paint wall color and type in classrooms. The results of measurements made for this purpose are seen in Table 3.

Table 3. Classroom wall color and type

School	Class	Studying in Class	Paint Color	Paint Types
A	A1	5 th grade	dark pink-Light pink	Plastic
	A2	7 th grade	dark pink-Light pink	Plastic
	B1	4 th grade	Magenta-Champagne	Plastic
B	B2	1 th grade	Light Blue- Lime green	Plastic
	C1	4 th grade	Pink- Champagne	Plastic
C	C2	4 th grade	Pink- Champagne	Plastic
	D1	2 th grade	Pink- White	Plastic
D	D2	2 th grade	Pink- Cream	Plastic
	E	E1	1 th grade	Pink
E2		1 th grade	Pink	Plastic

It is known that attention is not paid to the selection of color in schools. However, the colors that are used can motivate and influence behaviors positively or negatively [49]. It is possible to both draw attention and soothe students and teachers with color selection. In general when looked at classrooms that have been measured use two different colors. It is observed that pink, cream and rarely green color hues are used. According to Barker [14] in primary education warm colors (yellow, pink, etc.) in secondary education blue and green tones are preferred. Except the B2 classroom it can be said that all the right choices were made for the other classrooms. All schools use plastic paints on their walls. Water-based plastic paints, show excellent adhesion to all kinds of surfaces. It is easily wiped and washed with water. Therefore, an advantageous situation is presented in the terms for school hygiene conditions. The breathability quality of plastic paints allows for walls to expel their moisture outside. The paint is easy to apply and is fast drying. The colors didn't fade [50]. Therefore, plastic paints were found to be an appropriate choice.

4. 4. Some classroom physical measurements

Another situation that arouses curiosity during the scope of the research is the physical dimensions of a class. The physical dimensions were taken together with the number of students. Table 4 shows this data.

A Classroom ceiling height of 3 meters is recommended. In addition, 1.2 square meters of useable space per student needs to be planned [10]. It can be said that there is planning of specific measurements in terms of ceiling height. However, when an assessment is made in terms of usable space per student in classrooms B1, C1, C2, E1, measurement values close to 1.2 meters were obtained from this classroom. The number of students in other classrooms can be considered to be high. The most striking finding was in the A1 class. This class despite

Table 4. Physical measurements regarding some classrooms

School	Class	Studying in Class	Space Measurement (cm)	Space m ²	Number of students	Useable space per student m ²	Classroom ceiling height (cm)
A	A1	5 th grade	630x480	30.24	44	0.69	290
	A2	7 th grade	485x430	20.85	42	0.47	390
B	B1	4 th grade	820x630	51.66	34	1.17	332
	B2	1 th grade	660x720	47.52	25	1.08	300
C	C1	4 th grade	865x593	51.29	20	1.17	375
	C2	4 th grade	860x590	50.74	24	1.15	375
D	D1	2 th grade	790x590	46.61	24	1.06	280
	D2	2 th grade	790x590	46.61	26	1.06	280
E	E1	1 th grade	730x670	48.91	32	1.11	300
	E2	1 th grade	720x660	47.52	22	1.08	300

having the second smallest dimension of any classroom in this study had the highest number of students. In addition, the A1 and A2 classrooms within the scope of the research had the highest age group.

These two classrooms should be reorganized immediately. When evaluating all the results, we should keep in mind Basar's [5] research "The groups who are younger are in need of teachers more and the number of students in these classrooms should be kept relatively small."

5. Conclusions and recommendations

According to Sahan [51] the most important issue of today's system of education is improvement of individuals about physical, emotional, spiritual and social abilities to be beneficial for their society and for themselves. Bal [52] claims that the school conditions, curriculum and text books should be well-prepared so that education and training activities are achieved successfully. Student's health, physical, social and personal developments should be maintained in parallel with intellectual and academic ones [53]. Environmental problems affect humans' lives [54]. According to these views on the learning environment and teacher training are an issue which deserves attention [55-58].

Schools can be considered venues where children spend a significant part of their everyday life. Compared to other venues children's physical, social and mental activities are as a percentage of time higher than in other places at this venue. However, no serious review has been done of activities where these venues are located. These are among the duties that must not be delayed by parents of the students as well as those responsible for instruction, school administrators and teachers and political authorities that must take the decisions for these measures. Learning the variables within the classroom learning and comparing the measurements that were taken from the aspect of student's health was discussed in the previous sections. A general evaluation can be made is when appropriate measures are taken with the purpose of making educational environments more preferable and livable a possibility.

These measures can be shown as examples;

- Those variables in a classroom such as illumination, temperature and humidity values are regularly measured and when these values are brought to desired levels by use of centralized systems.
- That regular training is given to teachers and school administrators on probable behavioral changes in students based on conditions in the classroom environment.
- That teams be appointed from various experts (engineers, medical, education, etc.) to take part in the decision-making in the construction and inspection of schools.
- Isolation work can be done at schools near residencies, airports, power lines, base stations, factories etc. Or transporting these schools to more reliable areas can be provided for.
- That an air filtered environment be created through filtering systems for residential areas that are polluted.

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