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PROXEMIC AND NONVERBAL COMMUNICATION IN CLASSROOM INTERACTION

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ABSTRACT

This article reports a study carried out about teacher-student interaction in a public school in the early years, in the city of Santiago, Chile. The study performed a quantitative analysis of the frames of images captured by a mini camera mounted on eyeglasses of a group of 18 students. The selected frames were those that the teacher appears in the students' visual field. The analysis was developed from the concept of proxemics and the results show that there are times when the classroom teacher interacts with students at a closer level and, in others, there is a greater distance. Furthermore, it was possible to identify differences between boys and girls regarding the proxemic patterns of visual involvement in the interaction. The results of this study indicate new directions for the analysis of teacher-student interaction, focusing on non-verbal aspects in the construction of teaching and learning relationships.

Keywords: teacher student interaction; proxemics; nonverbal communication

Proxémica y comunicación no verbal en la interacción en sala de clase

RESUMEN

En este artículo se relata un estudio realizado sobre la interacción profesor-alumno en una escuela pública de los años iniciales, en la ciudad de Santiago, Chile. En el estudio se realizó un análisis cuantitativo de los cuadros de las imágenes capturadas por una minicámara montada en gafas de un grupo de 18 estudiantes. Los cuadros seleccionados fueron los que la profesora aparece en el campo visual de los alumnos. El análisis se desarrolló a partir del concepto de proxémica y los resultados apuntan que hay momentos en que la profesora de la sala de clase interactúa con los alumnos en un nivel más cercano, en otros, hay un alejamiento mayor. Además de eso, fue posible identificar diferencias entre niños y niñas cuanto a los patrones proxémicos de involucramiento visual en la interacción. Los resultados de este estudio señalizan nuevos sentidos para el análisis de la interacción profesor-alumno con enfoque en aspectos no verbales en la construcción de las relaciones de enseñanza y aprendizaje.

Palabras clave: interacción profesor-estudiante; proxémica; comunicación no verbal

Proxêmica e comunicação não verbal na interação em sala de aula

RESUMO

Este artigo relata um estudo realizado sobre a interação professor-aluno em uma escola pública dos anos iniciais, na cidade de Santiago, Chile. O estudo realizou uma análise quantitativa dos quadros das imagens capturadas por uma minicâmera montada em óculos de um grupo de 18 estudantes. Os quadros selecionados foram os que a professora aparece no campo visual dos alunos. A análise foi desenvolvida a partir do conceito de proxêmica e os resultados mostram que há momentos em que a professora da sala de aula interage com os alunos em um nível mais próximo e, em outros, há um distanciamento maior. Além disso, foi possível identificar diferenças entre meninos e meninas quanto aos padrões proxêmicos de envolvimento visual na interação. Os resultados deste estudo sinalizam novos sentidos para a análise da interação professor-aluno com foco em aspectos não verbais na construção das relações de ensino e aprendizagem.

Palavras-chave: interação professor-estudante; proxêmica; comunicação não-verbal

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INTRODUCTION

The classroom interactions are important social phenomena. The ways in which a teacher interacts with their students are fundamental for the construction of a communicative process that establishes links and better possibilities for understanding interaction in the classroom (Rosa & Farsani, 2021). This type of interaction construction represents important elements of the social relations patterns, which are not often considered to play an important role in educational processes. From research that has focused on classroom interaction, in general, the capture of these processes occurs by placing a camera on a tripod placed at the back of a classroom (Erickson, 1973; Condon, 1982; McNeill, 1992). We can say that the data captured by this camera would always represent a third-person perspective about interactions between teacher and students and among peers. In these cases, the camera's point of view could be understood to be an outside perspective. This third-person perspective would mean that the records of interaction are not being made from the teacher's and students' perspectives. In this study, we propose to incorporate a first person in the recording of the classroom interaction. To make this first-person perspective possible, interactive videos recording were made using mini video cameras mounted on glasses worn by students. Eyeglasses are technological devices that have been used, more recently, in educational research. This type of visual technology can provide new opportunities to record subtle but important patterns in classrooms (Sharma, Jermann, & Dillenbourg, 2015).

These glasses allow researchers to record and review events that the student observes, which makes it possible to perceive their point of view, making the vision of the interaction occur from a participant of the interaction. This visual can present several elements related to the student's visual attention, whether it is what is written on the blackboard or in the material that the student has in his/her desk, or else, perceiving gestures and visual elements that make up non-verbal communication. Also from this recording feature, it is possible to identify how much of the students' visual attention is given to the teacher and other students in the room.

In this study, we will present results about the students' visual attention in the classroom of a 38-year-old teacher with 10 years of teaching experience in a public school in the city of Santiago, Chile. Analyzing the data obtained by the mini video cameras mounted on the eyeglasses used by the students, we found two different patterns of interaction in this teacher's case. A first, in which there are times a month when she does not interact much with students, always keeping a distance, and a second pattern of interaction where there are times, in the same month, when she interacts much more with students, at different levels. greater proximity.

In this article, we intend to discuss these interactional classroom patterns, which were identified from the students' perspectives through videos generated by cameras mounted on their glasses. Students' visual attention is one of the most important aspects of nonverbal interaction in the classroom and plays an extremely significant role in interactional engagement and learning (Farsani, Breda, & Sala, 2020; Farsani, Radmehr, Alizadeh, & Zakariya, 2021). We will take the notion of *proxemics* to measure the interactional behavior in the classroom between the students and the teacher. The notion of proxemics in this study is related to the silent study of communication, often referred to as "people regulate themselves in space and how they move in space" (Collier, 1995, p. 235). We intend to explore how subtle changes in the teacher's proxemic behavior alter the dynamics of classroom interaction and student visual attention.

Proxemics: communication based on the use of space

The notion of **proxemics** can be understood as a part of non-verbal language (or body language). There are several studies in this field that look at how small changes in our body language can have significant effects on social interaction. For example, a more open and expansive body posture, such as standing and having a lot of space between your feet, with your hands on your hips, lead to changes in perception and interactional behavior, according to the study developed by Carney, Cuddy and Yap (2015). In this study, the authors discuss how this type of nonverbal behavior is often associated with a higher probability of being hired in a simulated job interview (Cuddy, Wilmuth, Yap, & Carney, 2015). This same bodily behavior can increase experiences related to positive emotions and decrease experiences of negative emotions, as discussed by Veenstra, Schneider and Koole (2017). As another example, something as basic as an "upright posture" can have positive effects on children's academic achievement. In this sense, in Japan, the study developed by Inagaki, Shimizu and Sakairi (2018) identified positive effects on academic writing productivity, as well as better scores on a calculus test, when students adopted an upright posture. In another study carried out in the United Kingdom, Farsani (2015) explored how the body orientation and the teacher's angle of turn in relation to the interlocutors play an important role in the process of student engagement during mathematics classes.

This concept of proxemics, coined by the American anthropologist Edward T. Hall (1959), attracted many contemporary anthropologists, psychologists, and educators. Hall proposed in his studies an analysis of the proxemics of interpersonal communication in different

cultural contexts. For this, he proposed four categories to address people's use of space in interactions, focusing on the distance they maintain from other interactants: intimate space (up to 45cm), personal space (up to 120cm), social space (up to 370cm) and public space (more than 370cm). In this article, when dealing with interactions in the classroom, we will make use of the four categories referring to the use of space: Private, Personal, Professional and Public. In addition, we would like to examine which of these four spaces has the greatest effect on students' visual attention.

Hall (1959), in addition to discussing how "space speaks" in social interactions, also noted that people from different cultures use space in different ways in their social communication encounters. Just as verbal language varies in each cultural context, so does the use of space between social dyads. For example, one of the authors of this article lived in three very different countries, each on a different continent (Iran, United Kingdom, and Chile), all of which have diametrically opposed interactive sociocultural norms. He immediately realized that the British, Iranians, and Chileans have fundamentally different proxemics systems in their social and communicative encounters.

What is considered a socially acceptable personal distance between social dyads in the UK can be considered rude or even offensive in Chile. In England, it is socially acceptable to stand at a distance of three feet from other interlocutors. In Iran, this distance is a little smaller (Mehrabian, 1972), while in Chile the interlocutors are even closer during interpersonal communication. In England, the proximity between interlocutors can lead individuals to show signs of discomfort, from a very classic gesture of crossing your arms to the use of the verbal expression "get your face off mine". It is possible to state that the sociocultural norms of proxemics behavior vary considerably in Iran and Chile, when compared to the United Kingdom. In Iran, as the interpersonal space between social dyads increases, this can result in Iranians saying sentences that express discomfort such as "I can't smell" or "I can't smell you ". It simply means "I can't smell it and neither can you, so let's get closer."

In Chile, due to sociocultural norms, personal space is even closer than in Iran. In Chile, being at a distance between social dyads is socially rude and considered bad practice. In such circumstances, Chileans become more aware and show their discomfort through the expression "No muerdo!", which translates to "I don't bite." This phrase probably reflects the closeness that Chilean interlocutors would expect from each other in social interactions. It is interesting to note that the notion of proxemics varies not only among cultures, but also among individuals and situations. For example, people around the world tend to keep closer in subways or elevators. Also, interlocutors tend to get closer than usual in noisy environments.

The notion of proxemics can raise important questions for thinking about teacher/student interactions, when we focus on how the uses of visual space and the participants' bodily positions play a role in these interactions in which learning relationships are established. Proxemics is often seen as a resource that teachers can routinely use, not only to regulate a shift-taking process in the interaction more smoothly, but also with the aim of observing how non-verbal and unconscious behaviors teachers can promote certain interactive patterns in the classroom (Roger, 2015).

Other researchers have examined the effects of the use of different languages spoken by bilingual learners on their proxemics changes and nonverbal behaviors (Collier 1983, Farsani, 2015; 2016). For example, Collier (1983) carried out a proxemics study pointing out that interpersonal distance is a significant factor in classroom interaction, according to the interactive cultural patterns involved. In his analysis, taken from a detailed video recording of a Chinese-American classroom, Collier showed that the language of instruction determined particular patterns of proxemics and interpersonal spaces. The Cantonese language spoken by the students, when used as a means of instruction, not only caused a closer proxemics space between the interlocutors, but also significantly enabled more turning angles (the body) between students and teacher. This situation allowed for a more engaging atmosphere and increased student attention. In addition, students were more likely to communicate on topics related to the task performed.

The study developed by Farsani (2015), about proxemics behavior among students of Persian descent in the UK, focused on the multimodal mathematical messages exchanged between British-Iranian students in the interaction. In addition, the author examined the ways in which different languages (English and Farsi) affected students' body orientation and proxemics behavior in classroom interaction. English was often used to keep technical school tasks moving, while Farsi was used for making jokes, managing behavior and emotional engagement, so Farsi was used as a verbal trigger that produced an angle of closer approach and bodily attention among the students. In this sense, it is possible to think about how proxemics varies according to the different roles of language and languages in use in social interaction. Proxemics can also be observed in relation to cultural and gender differences within society. Therefore, Author 1 observed that the girls maintained more proximity in the direction of the body (the turning angle) facing the other, while discussing ideas and developing tasks. On the other hand, the boys maintained a greater body distance, with a smaller turning angle and less eye contact with each other.

Several previous studies on language and classroom interaction have shown the different effects that verbal language can have on the construction of learning relations (Barreira & Maluf, 2004; Bernardes, 2011; Kripka, Quadros, Oliveira, & Ramos, 2017). We understand that studies on classroom interaction with a focus on non-verbal elements that make up these interactions, particularly studies on proxemics communication, can bring relevant aspects to think about learning processes in the classroom. Furthermore, it is interesting to investigate how issues of gender and other possible categories of space, related to cultural differences in the classroom, can affect the visual attention of students in different topics covered.

METHOD

The data collection for this study was carried out from records in a classroom, on three different days (28.07.2017; 11.08.2017; and 25.08.2017), in a school in the early years in the city of Santiago, Chile. Each recording moment consisted of two consecutive 45-minute classes (90 minutes per day). At these meetings, the classroom teacher and a sample of 18 randomly selected students (6 students per day) were invited to use a mini video camera mounted on spectacle frames.

The data discussed in this article are part of a larger research that aims to investigate patterns of interactional behavior by the classroom teacher and students. Our focus is to capture and analyze the patterns of gaze between students and the teacher in the classroom, in order to promote a *locus* of observation on interactive classroom practices from the perspective of a first-person participant in the interaction (Prieto, Sharma, & Dillenbourg, 2015). The idea of using the gaze as a means to analyze how teaching and learning relationships are built is of particular interest to many researchers. In our earlier work, we paid special attention to the importance of a first-person point of view, something that traditionally research on interaction has not been done; in general, in these studies, the positioning of the camera always starts from a third look, be it a fixed point in the room, or the eye of a researcher who operates the camera.

By mounting the cameras on the students' glasses, we were able to calculate and get a better perspective of the class from the student's view. The average age of participating students was around 6 to 7 years. 12 boys and 6 girls were randomly selected. In total, we obtained almost 27 hours of interactional recordings made from the perspective of the students. These video cameras had a recording quality of thirty frames per second (30 fps) for each video. Each *frame* was sampled within each second, in order to detect the presence of faces in the image. Assembling a mini video camera did not represent a big change, nor a big disturbance for the students, only initially, however, after a while, the camera in the glasses became an easily incorporated object. In our experience, after a few minutes, students completely forget that they are wearing their glasses.

Automated Visual Processing for Quantitative Analysis of Proxemics in the Classroom

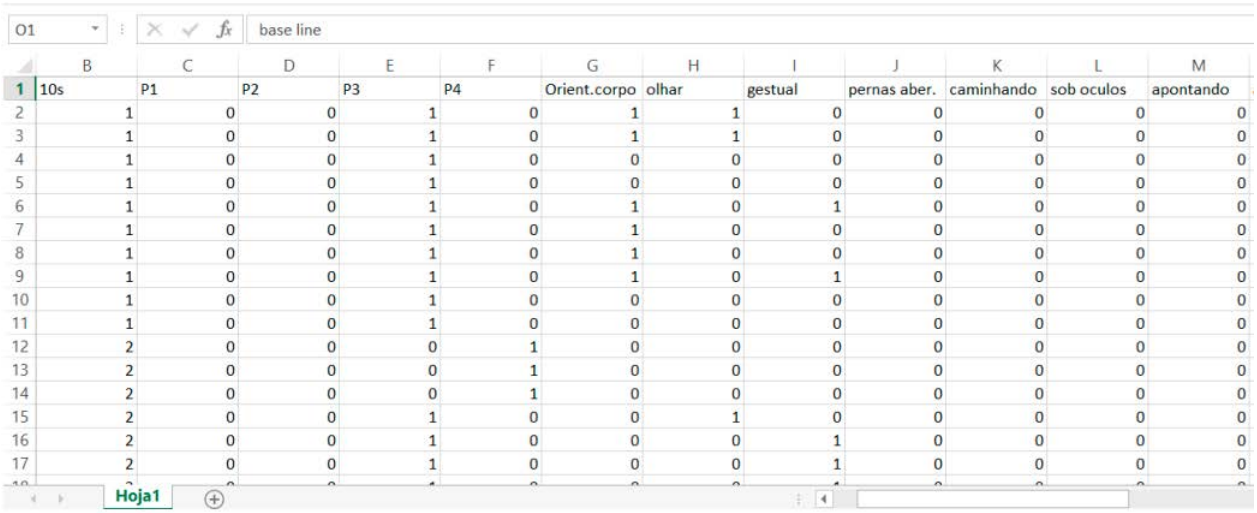
Incorporating visual technology to observe interaction can provide new opportunities to observe subtle but important patterns in interactive classroom practices. For the analysis of these patterns, from this visual production, it is possible to incorporate quantitative aspects by measuring and analyzing the uses of space. In the qualitative aspects, it is possible to think about the continuity of the study by the search for the production of meanings by the participants for these interaction patterns in question.

In this article, we intend to present a quantitative analysis from an automated and objective methodological approach to analyze the frames produced in the visual data. For all sampled frames we used the *Google Images* feature to identify the presence of faces. We inserted photos of the teacher in the classroom and this feature automatically and objectively identified all the frames in which an image of the teacher appeared in each frame captured by the students. A total of 97200 frames were analyzed. Our interest was mainly in cases where students kept their visual attention on the teacher. There were times when more than two faces were present on the same board, for example, when the teacher appeared and another student who had just arrived at class. In these cases, we decided to discard the board, as the student's visual attention could have been fixed on the other student who was next to the teacher and not on her. There were other times when we deliberately discarded frames that were not accounted for in the quantitative analysis, this included those where the sharpness of the frames was low or blurred and therefore it was not possible to discern whether or not the teacher was looking at the student.

After the image identification feature detected the teacher's face on a board (captured by the students' glasses), that board was given a unique identification number and was also examined individually to observe some non-verbal variables. For example, if the teacher was looking directly at the students, if she was gesturing, pointing, walking, sitting (see Figure 1), and finally, her proxemics distance from the student who recorded the image through her glasses. This process was organized in an Excel spreadsheet, with double entry 0 or 1 (indicating 'if it didn't happen' (0) or 'if it happened' (1), and then statistical analyzes were performed to measure these occurrences.

Figure 1 illustrates a set of variables, for example, p1,

Figure 1. *Exam of Nonverbal Variables.*



O1 | base line

	B	C	D	E	F	G	H	I	J	K	L	M
1	10s	P1	P2	P3	P4	Orient.corpo	olhar	gestual	pernas aber.	caminhando	sob oculos	apontando
2	1	0	0	1	0	1	1	0	0	0	0	0
3	1	0	0	1	0	1	1	0	0	0	0	0
4	1	0	0	1	0	0	0	0	0	0	0	0
5	1	0	0	1	0	0	0	0	0	0	0	0
6	1	0	0	1	0	1	0	1	0	0	0	0
7	1	0	0	1	0	1	0	0	0	0	0	0
8	1	0	0	1	0	1	0	0	0	0	0	0
9	1	0	0	1	0	1	0	1	0	0	0	0
10	1	0	0	1	0	0	0	0	0	0	0	0
11	1	0	0	1	0	0	0	0	0	0	0	0
12	2	0	0	0	1	0	0	0	0	0	0	0
13	2	0	0	0	1	0	0	0	0	0	0	0
14	2	0	0	0	1	0	0	0	0	0	0	0
15	2	0	0	1	0	0	1	0	0	0	0	0
16	2	0	0	1	0	0	0	1	0	0	0	0
17	2	0	0	1	0	0	0	1	0	0	0	0

Hoja1

p2, p3 and p4, where p1 is when the teacher appears in a student's private space, p2 in the personal space, p3 in the professional space, and p4 in the public space of the student. student. We also consider other variables, such as whether the teacher has direct eye contact with the students, whether the teacher's body is facing toward the students or towards them.

DISCUSSION: MEASURING THE PROXEMICS IN TEACHER-STUDENT INTERACTION

For the analysis, we considered proxemics as an integral part of the teacher-student interaction. For this, our focus was on observing how each student and teacher were positioned in relation to each other, moment by moment. In the analysis of proxemics, we measured how far the teacher was standing, or sitting, in relation to the student-observer in question. We also recorded the distance at which each student was seated in the classroom, for this, a physical measure of the distance between the tables in the lateral and sagittal planes (from left to right and from front to back, respectively) was taken. As a result, we observed that the tables were three feet apart (left to right), with three feet between each row (front to back). Sitting at their desks, each student used approximately 110 cm of space in total (front to back). Therefore, if the student-observer was seated in the second row, in the same column as the teacher, the distance between the observer and the teacher would be around approximately 220 cm.

Pythagoras' rule was used to identify the distance between the student-observer and the teacher if the teacher was standing (or sitting) in a different column from where this observer was sitting. By getting a rough estimate of how far away the observer was from the teacher, we classified each frame in terms of the proxemics: private, personal, professional, and public space.

For the study of proxemics in classroom interaction, we performed a quantitative analysis based on the numerical data obtained, organized in an Excel spreadsheet, from the quantification of non-verbal variables. An analysis of variance was used, from the *two-way ANOVA* resource, with double entry: the date of the class and the gender of the students as the two main factors. The significance level was set at 0.05 and Bonferroni's adjustment was applied to p values. We present four different graphs, each graph representing the teacher's proxemics pattern in relation to her distance from the students. Furthermore, we consider the gender of students as another factor, in order to observe whether there are differences in proxemics preferences regarding girls and boys. Also note whether these placements can help them pay more visual attention to the teacher and get involved in the lesson. Thus, it is interesting to think about how gender relations can raise questions about proxemics in classroom interaction.

Proxemics: approximation and distance between teacher and students

The case of private space

The private space is identified when the distance between the teacher in the classroom and the student is from 0 cm (when there is touch) to 45 cm. It appears that on this specific date (28.07.2017), there was a significant effect on the average number of frames in which students looked at the teacher, at a distance of proximity 1 ($F2, 15 = 4.97$, $p = 0.027$). *Post-hoc* tests showed a significant difference between class 1 (28 - 07) and class 2 (11 - 08) ($p = 0.04$). The effect differences between sexes in the mean number of frames were not

significant (F1, 16 = 4.13, p = 0.065).

The case of personal space

Personal space is identified when the distance between the teacher in the classroom and the student is 46 to 120 cm. For p2, there was a significant main aspect in relation to the class date (F2, 15 = 3.77, p = 0.055) and the gender aspect was not significant (F1, 16 = 2.00, p = 0.186). However, there was a significant interaction between the date of the class and the sex of students (F5, 12 = 3.21, p = 0.045), indicating that the date of the class in which the class took place significantly affected the difference between boys and girls in the first and in the third class (t12 = -2.59, p = 0.024).

The case of professional distance

The professional space occurs when the distance between the teacher in the classroom and the student is 121 to 360 cm. For professional distance, there was no significant main effect of class date (F2, 15 = 0.27, p = 0.772) nor student sex (F1, 16 = 3.04, p = 0.107). The interaction between class date and gender was not significant (F5, 12 = 1.5, p = 0.263).

The case of public space

The public space indicates that the distance between the teacher in the classroom and the student is greater than 360 cm. For the public space, there was no significant main aspect of class date (F2, 15 = 0.886, p = 0.438) nor gender (F1, 16 = 0.175, p = 0.683). The interaction between class date and gender was also not significant (F5, 12 = 1,865, p = 0.175).

These results, taken together, suggest that there are times during the month when there is a differentiation in the teacher's interactional behavior in relation to proxemics spaces: private and personal spaces (as of 28.07.2017). However, two weeks later (11.08.2017), this proxemics pattern of interactional behavior drops and there is no longer any approximation of students. Later, two weeks later (25.08.2017), there seems to be an increase in the interactional proximity of the classroom. This means that there are times a month when the classroom teacher is more physically and non-verbally involved, using all the space available to her in her professional teaching practice. Furthermore, it is interesting to note that, from this very small sample that we have, girls were visually more engaged and paid more visual attention to the teacher, especially when the teacher maintained personal space with these students. On the other hand, this was not significant in relation to other types of space and, in the case of interaction with boys, there was no such significance either.

Figure 3. *Interaction in Personal Space.*

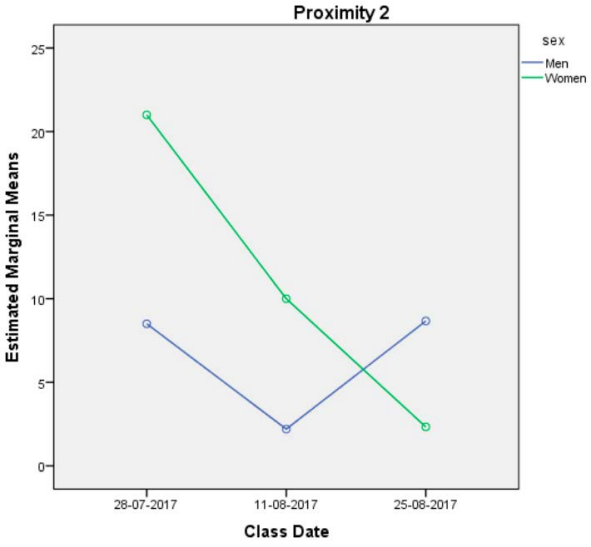


Figure 2. *Interaction in Private Space.*

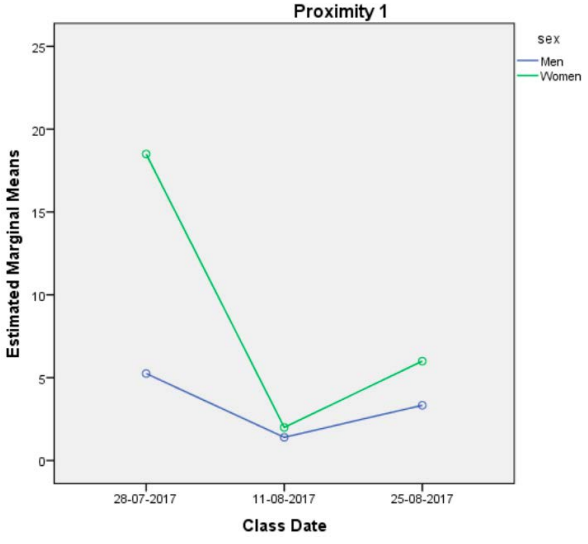


Figure 4. *Interaction in the Professional Space.*

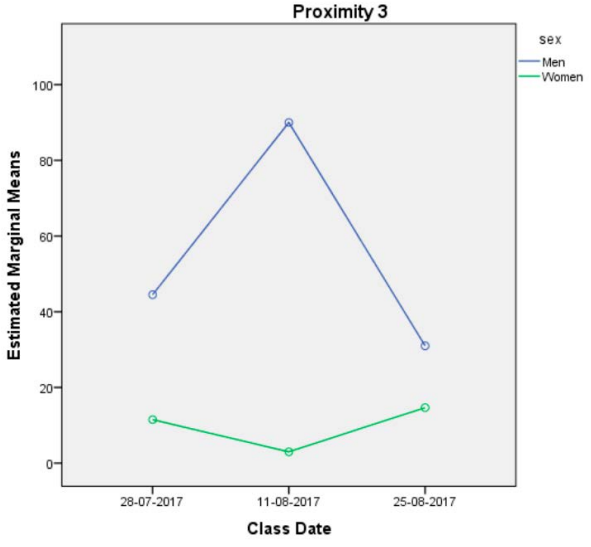
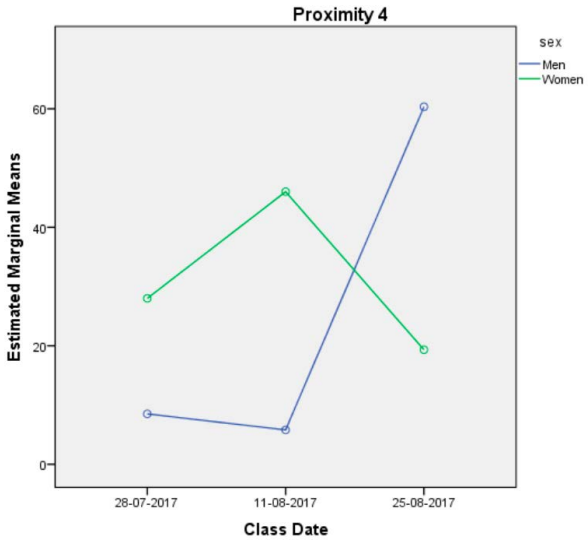


Figure 5. *Interaction in the Public Space.*



It is possible to identify, in this way, a movement in the teacher's proxemics behaviors in relation to the students, which vary throughout the month in which the classes were recorded: with moments of greater proximity (from 0 to 120cm) and distance. There were times when the teacher did not interact as much, keeping physically farther away from the students (more than 3.6 meters) and, in many of these moments, she used the table as a barrier between her and the students.

Furthermore, it was possible to identify differences in the preferences of proxemics patterns when considering the issue of gender. Boys and girls were shown to prefer specific proxemics patterns for visually engaging, especially in personal space.

FINAL CONSIDERATIONS

This article presented a study carried out in the early years in a public school in Chile, where a sample of 18 students, randomly selected, used a mini video camera mounted on glasses. Our results show that there were moments, within a month, when the classroom teacher interacted with the students at a closer proxemics level (from 0 to 120 cm). We also identified that there were times, in this same period, when the teacher did not interact as much, she was physically farther away from the students (more than 3.6 meters) and also used the table as a barrier between her and the students. In addition, boys and girls showed preferences for specific proxemics patterns to engage visually, especially in personal space.

We can say that so far there are few methodological tools developed to objectively and automatically measure visual attention, in the hope of measuring and evaluating visual involvement in relation to proxemics in the classroom. Studies are still needed to examine how subtle nonverbal and proxemics changes may be more likely to directly affect students' visual attention, taking gender issues into account. We would also like to expand and examine where in the physical space of the classroom and at what distance (the proxemics relationship between teacher and students) there are students who are likely to be visually more or less involved with the teacher.

These results indicate the relevance of developing future studies that seek to articulate the issue of proxemics in the classroom, from the pointed out space categories, with the discursive practices that are verbally exchanged within each of the four different spaces. Furthermore, as a continuation of this study, questions that lead to a qualitative analysis can be listed. These questions discuss the interaction in the classroom from the meanings produced by the participants of the interaction for these types of organization of the use of space. For this, it is interesting to highlight the development of an analysis that takes into account particular and specific aspects, referring to the cultural meanings that the participants bring to the interaction, with a focus on the uses of space, that is, to discuss how meanings are produced by the participants for the proxemics raised in the classroom.

Furthermore, it is important to emphasize that studies of classroom interaction can bring aspects to discuss the forms, styles and quality of messages that are transmitted verbally and non-verbally, which can contribute to the professional practice of teachers. We believe that optimizations of these non-verbal messages, often very subtle and silent, can have a direct positive effect, not only among students who are visually involved, but also in building the teaching and learning relationships that are established in the classroom. of class. A recommendation for thinking about teacher education is to incorporate in the discussions, promoted in these formative processes, the communicative functions of the non-verbal language in the classroom.

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