window


window
white board
Student 3
Student 2
Student 1
Instructor's tall support table & bench
ructor
multimedia projector
students' desks & chairs
students' desks & chairs
Student
tudent 2
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ATIONS:

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Analyzing Multimodal Interaction
within a Classroom Setting

ABSTRACT

Human interactions are multimodal in nature. From simple to complex forms of transferal of information, human beings draw on a multiplicity of communicative modes, such as intonation and gaze, to make sense of everyday experiences. Likewise, the learning process, either within traditional classrooms or Virtual Learning Environments, is shaped by learners' perceptions of what is being communicated multimodally to them intentionally or not, and by the perceptible pedagogical affordances of the environment.

This paper examines the specific place of action and multimodal interaction within the learning process. It starts by defining learning and multimodal interaction. Next, it expands on an existing methodological framework for analyzing multimodal interaction in order to include affordances for learning and to visually map the central role of action to learning. Finally, it makes use of the reviewed methodological framework to analyze a video ethnographic study of interactions that take place within a graduate Design classroom.

INTRODUCTION

Any view of learning reflects its underlying theories. In the present study, it is assumed that learning is situated in particular sociocultural contexts, and it is the result of mediated experiences that are afforded (Gibson, 1986) or constrained by interactions with the situation (King et al., 2001). In this way, the possibilities and limitations for action in particular situations affect learning. Furthermore, learning takes place whenever and wherever the individual is receptive. It can have different purposes or intentions, which, according to King, Young, Drivere-Richmond and Schrader (2001), can be classified into: a) objective-driven learning, such as in instruction; b) non-objective driven learning, such as in exploration; and c) unintended learning.

With regard to the relation between learning and multimodal interaction, it is possible to affirm that learning is woven with multimodal interaction. Discourse analysis studies in educational settings (Cazden, 2001; Adger, 2001; Mehan, 1979; Gumperz and Herasimchuk, 1975) have been trying to uncover the way in which talk in school is unique, helping to explicate the actions in which learning is realized. The emphasis on the linguistic aspect of classroom interaction, however, fails to account for the multiple fused semiotic modalities that together, rather than separately, help extend the understanding of the learning that takes place.

Jürgen Ruesch and A. Rodney Prestwood were pioneers in bringing embodiment as communication into the applied arena of the human sciences (Lanigan, 1995). In early multimodal studies, "Anxiety: Its initiation, communication and interpersonal management" (Ruesch and Prestwood, 1949) and *Communication and bodily disease: A study of vasopastic conditions* (Ruesch and Prestwood, 1950), the authors affirmed that the whole body can be looked upon as an instrument of communication. In 1951, Ruesch and Bateson, *Communication: The social matrix of psychiatry*, examined the asymmetrical communication interactions between psychotherapy supervisors and supervisees, taking note of the embodiment applications to communication and the diagnosis of stressed embodiment. For instance, within a group of the twelve women and nine men who had undergone major operations (Ruesch and Prestwood, 1950), the majority had significant problems with human interaction and social process. The negative embodiment was manifest in a number of communication factors in the patients' comportment, such as inadequate gestures, poor system of codification and inability to consider the double meaning of communication actions.

Within educational settings, multimodal studies are more recent. Kress, Jewitt, Ogborn, and Tsatsarelis (2001a) conducted a multimodal study of school-based teaching in order to challenge the assumption that learning and

teaching are primarily linguistic accomplishments, and not visual and actional. The authors show that classroom texts are realized through the interaction of different modes of communication or organized means of representation. For example, the construction of the entity 'cell' in a year 7 Science classroom involved speech, action – in the form of experimentation and image. The process of construction also involved the transformation of information across modes, e.g., verbal analogy to visual analogy, and experimentation into written report. Here, communication is extended to refer to all meaning-making systems.

Bourne and Jewitt (2003), for example, took a multimodal approach to understand the ways in which the interpretation of literary texts is constructed through social interaction. The authors look at a year 10 English classroom, showing that higher-order literacy skills are realized and constructed through the configuration of talk, writing, gesture, gaze, movement and posture. An example is the use of a diagram by the teacher to talk about the abstract notion of gender and link the behavior of male students to the characters in the story and men in general. The authors show that the understanding of teaching and learning is facilitated and extended through the multimodal analysis of social interactions.

The present study examines the specific place of multimodal interaction within the learning process of a graduate Design classroom. It also seeks to identify the classroom affordances for perception and interaction, and to visually map the central role of action to learning.

A METHODOLOGICAL FRAMEWORK FOR ANALYZING MULTIMODAL INTERACTION AND LEARNING

In order to build on an existing methodological framework for analyzing multimodal interaction, so to include affordances for learning and the visual mapping of the significance of action, it is important to briefly discuss, first, the concepts of affordances, multimodality, interaction and communicative modes, then, to present a framework developed by Sigrid Norris (2004a) and to point to expansions made for the analysis of a graduate Design class.

AFFORDANCES

Traditional classroom communication is structured by bodily experience (Rohrer, 1998) and so is learning. And since learning is always situated, each situation places limitations on the interaction and makes some activities possible. Here, possibilities for action are understood as Gibson's notion of

affordances (Gibson, 1986). According to Gaver (1991, 2), "affordances per se are independent of perception." They exist whether attention is being paid to them or not, whether they are perceived or not, and whether there is perceptual information for them or not. For instance, an apple affords eating whether someone is hungry or not. Affordances, in this way, can be called perceptible or hidden, depending on whether there is perceptual information for them or not. Hidden affordances must be inferred from other evidence. If the information available to an individual suggests a nonexistent affordance, then the individual might mistakenly try to act on a false affordance. In addition, the individual will usually not think of a given action if perceptual information about the affordance is not present. In conclusion, separating affordances from the perceptible information about them allows making a distinction among correct rejections, perceived affordances, hidden affordances and false affordances. The analysis of affordances can directly suggest implications for design.

MULTIMODALITY

According to Kress (2004), multimodality deals with all the means human beings have for making meaning, referring to the modes of representation, such as drawing or writing. The author affirms that each mode forces individuals into making commitments about meaning, whether intended or not.

Multimodality is based on the use of sensory modalities by which humans receive information, such as touch, vision, audition etc. and requests the use of at least two response modalities regarding presentation of information, like verbal and manual activity (Baber & Mellor, 2001).

The prefix 'multi' literally means 'more than one' and the term 'modal' refers to the notions of 'modality' and 'mode.' Modality relates to the type of communication channel being used to convey or acquire information, and the individuals have access to a wide range of them through which they typically interact. Mode refers to a state in which the way a piece of information is interpreted or extracted to convey meaning is determined. Some examples are: gesture, movement, sound-effect, speech, writing and image.

Modes can be realized in more than one production medium. Media correspond to the material resources used in the production of semiotic products and events, including both tools and materials (Kress and Leeuwen, 2001), like printed books, CD-ROMs or computer applications.

In a communication act, whether between humans or between a computer system and a user, modality, mode and medium come into play. The modality defines the type of data exchanged, whereas the mode determines the context in which the data is interpreted and media gives the material support.

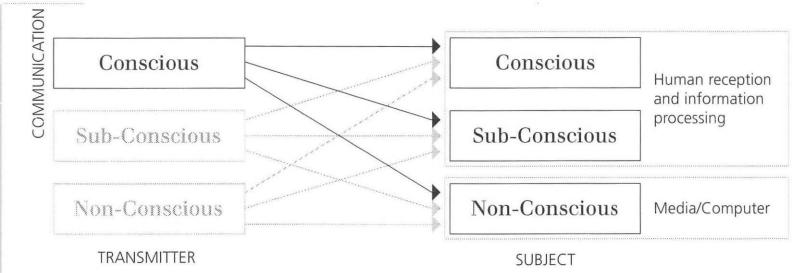
INTERACTION

According to Beaudouin-Lafon (2004), interaction can be viewed as a sensory-motor phenomenon, where the user input generates an output perceived by the user. According to Whittaker and Walker (1991), interaction can be seen as a negotiation process in which participants give and receive evidence for understanding in a manner that is incremental and concurrent.

Munck and Mayer (2000) describe interaction as a broader category within which communication is a specific type. It is the process of having a mutual effect, involving transferal of information with or without an intention behind it.

Interaction, in this way, can have nine forms of transferal of information — a conscious or intentional transmission of information that is received consciously, subconsciously or by a medium with no consciousness; a sub-conscious transmission of information, that is received in the same three ways; or a non-conscious piece of information, also received in the same three ways (*figure 1*). Communication, on the other hand, can have three of them — the ones where there is an intention behind the transferal.

Figure 1 Transferal of information (Adapted from Munck and Mayer, 2000)



By combining these views of interaction and communication, the authors conclude that certain types of perceived communication are not communication, but interpretation of signals and move to the re-definition of interaction. In this new approach, interaction is still rooted in the objectification of the subject, but instead of having a conscious human subject, it adopts a media with a faculty for being effected by the interaction. The interactivity of a situation, consequently, looks both at the ability of artificial or living entities participating in the interaction to objectify themselves as part of the exchange and the ability of the media to transmit this mutual effect, where purposes are mutually dependent.

According to Norris (2004a, 2), all interaction is multimodal and individuals' perception of everyday interactions is shaped by more than what is said. Human beings communicate through, for example, facial expressions, gaze, gestures, body posture and proxemics – or the distance between people. "All movements, all noises, and all material objects carry interactional meaning

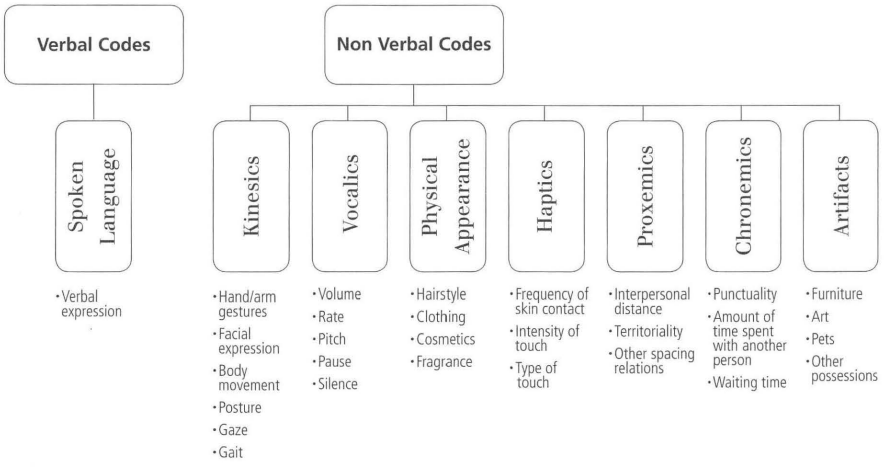
as soon as they are perceived by a person." Whittaker and Walker (1991) affirm that multimodal interaction should involve bidirectional communication through more than one modality.

COMMUNICATIVE MODES

Communicative modes, like head movement, gesture and spoken language are all systems of representation. Kress and Van Leeuwen (2001) affirm that a system of representation is a semiotic system that includes rules and regularities. In Norris (2004a), a communicative mode is never a static unit, but a heuristic unit, meaning that it can be defined in various ways and it has no clear boundaries. For instance, furniture can be a communicative mode or an element within the layout mode.

The behaviors that constitute nonverbal communication can be categorized into seven types of nonverbal codes, according to Ciccia, Step and Turkstra (2003), within which several communicative modes are found (*figure 2*): kinesics (messages sent by the body, including communicative modes such as hand/arm gestures, facial expression, body movement, posture, gaze and gait), vocalics (paralinguistic or vocal cues other than words, including volume, rate, pitch, pausing and silence), physical appearance (manipulable cues related to the body, including hairstyle, clothing, cosmetics and fragrance), haptics (skin contact cues, including frequency, intensity and type of touch), proxemics (spatial cues, including interpersonal distance, territoriality and other spacing relationships), chronemics (use of time as a message system, including punctuality, amount of time spent with someone and waiting time) and artifacts (manipulable objects in the environment that reflect messages from the user or designer, such as furniture, art, pets and other possessions).

Figure 2 Verbal and non-verbal codes



Blatner (2002) suggests thirteen categories of nonverbal communication: personal space, posture, gesture, pacing, eye contact, paralanguage, touch, adornment, physiologic responses, position, expression, locomotion and context.

Spoken language is a category from verbal communication that can be either heuristically defined as a communicative code or mode, including several sub-units, such as cooperative overlap (Tannen, 1984). Although usually sequentially organized, from smaller parts that add up to larger ones, it can also be realized simultaneously.

Proxemics refers to the ways in which individuals arrange and make use of their space. The distance individuals take from one another and in relation to relevant objects are both a focus of concern. Proxemic behavior is culturally conditioned and gives insight into the kind of social interaction that is taking place and the level of formality or informality involved. Hall (1966) distinguishes four types of distance: intimate, personal, social and public. This heuristic unit is sometimes defined as a communicative code and sometimes defined as a communicative mode.

Hall distinguishes four types of distance: intimate, personal, social and public.

Posture relates to the ways in which individuals position their bodies during interaction, including form of the body, such as open or closed arms and legs (Dittman, 1987) and postural direction taken by an individual towards others.

In the literature, gesture may refer to hand and arm movements only or include facial expressions and eye gestures. It is easier, however, to analyze them as separate communicative modes. According to Kendon (1978), hand and arm gestures are deliberately expressive movements with sharp boundaries of onset, including elements and a trajectory. According to Norris (2004a, 28), "hand and arm movements are often interdependent and concurrent with spoken language, slightly preceding the spoken discourse." Often, it is difficult to recognize the meaning of a gesture without language. The major types of hand/arm gestures can be classified into: iconic, metaphoric, deictic and beat. The face is a highly developed organ of expression. Facial expressions many times reveal feelings that the individual is not intending to communicate or even aware of (Ekman, 2002). Some examples are: pensive, amused, anxious or confused.

Head movement refers to the ways individuals position their heads, and can be distinguished between: rotational (shaking the head), lateral (tilting the head to the right or left) and sagittal (nodding movements).

Gaze relates to the organization, direction and intensity of looking, and it varies from culture to culture and subculture to subculture.

Other possible communicative modes are, for example: music, print, color, layout, dress, object handling and touch.

MULTIMODAL INTERACTION FRAMEWORK

Understanding the different communicative modes in isolation is the first step for understanding multimodal interaction (Norris, 2004b). One of the challenges for the analysis of multimodal interaction relates to the different structures of the various communicative modes, which may be sequential, globally synthetic, functional or appear randomly structured. Another challenge is the need to make clear links between the analysis of interaction and the analysis of a person's awareness, referring only to the awareness and attention that individuals express during interaction and to which others react (Norris, 2004a).

The methodological framework for analyzing multimodal interaction developed by Norris suggests that the communicative modes should first be defined and the actions, or interactional meaning units, identified next. The author classifies actions into: higher level (bracketed by an opening and a closing, such as a conversation and made up of a multiplicity of chained lower-level actions), lower-level (smallest interactional meaning unit, such as an intonation unit within a chain of units of intonation used during the conversation) and frozen (higher-level actions that are performed by an individual or group of people anytime before the interaction and that are entailed or frozen in the material objects, such as a magazine lying on the table).

Understanding the different communicative modes in isolation is the first step for understanding multimodal interaction.

Next, the communicative modes are analyzed separately. Then, the modes that are interdependent upon one another are analyzed in combination, with their hierarchical structure interconnected. Finally, all communicative modes are looked at together.

The analysis framework proposed here starts with the identification of the use of major patterns of time and space, which allows the visual mapping of the importance of action within the learning process. This step is followed by the selection of higher level actions for detailed analysis (for example, a conversation) and identification of the intermediate level actions (which are

smaller sequences of actions within a higher level action, for instance, 'Sally turns to John to ask what time they will need to leave, followed by John's reply') and lower level actions within each (such as an intonation unit); succeeded by the definition of the heuristic larger units or communicative codes of analysis (kinesics for example) and, within each, the heuristic units or communicative modes of analysis (such as facial expression), as well as the sub-units within each (like eye gesture). These steps are followed by the analysis of each communicative mode with all its sub-units separately, as suggested by Norris (2004a), then the communicative codes in combination, next the communicative code and, finally, the entire higher level action.

In order to include affordances for learning, the group of lower, intermediate and higher level actions are related to their affordances (Gibson, 1986) and perceptible affordances (Gaver, 1991) within a table.

LEARNING AND MULTIMODAL INTERACTION WITHIN A GRADUATE DESIGN CLASSROOM

This section presents a video ethnographic study of interactions that take place within a graduate Design classroom and the analysis of the multimodal interaction that takes place within it, as well as identifies the affordances for learning and maps the central role of action within the learning process. It starts by describing the classroom context and narrating the student demographics. The names of the instructor and students were removed; they are referred to simply as instructor and student A, B or C. The exact title of the class was also masked to protect the identity of the participants.

The class takes place in the evening, starting at 6:30 p.m. and ending at 9:30 p.m. The group of forty-four students is heterogeneous in relation to nationality, with thirty-three American students and the other eleven coming from countries such as South Korea, India, Thailand, China and Spain. There are equal numbers of male and female students. The age of the students varies from twenty-five to forty-seven. The educational background is also varied, with about half of the students coming from a Design background and the other half coming from many different fields, such as Engineering, Music, Physics, Mass Communication, Architecture, Psychology and Anthropology. According to the course plan developed by the instructor, "This foundation course takes us [the students and instructor] on a brisk journey to connect ideas ranging from the [class title] fundamentals, to modern frontiers of design and innovation [...]." The one page course plan includes a brief overview of the course, the format for the classes, grading opportunities, schedule and main topic covered and commentaries regarding class participation. The syllabus, however, lacks other common elements such as clear learning goals and objectives, a detailed course content structure, required readings, responsibilities, and grading standards.

The observed class was the second class in the a seven class sequence, following the introductory class where the students were presented with overall goals and structure for the course and were lectured regarding the fundamentals of the topic for an hour. Prior to the observed class, the students were instructed to form groups and work post-class on a presentation emphasizing strategies of the enterprise assigned to them, based on two articles given in class. As identified in the syllabus, the instructor for this course adopted a student presentation and discussion format. The affordances of this model will be discussed in the next section, which starts by discussing the use of time and space in the observed classroom.

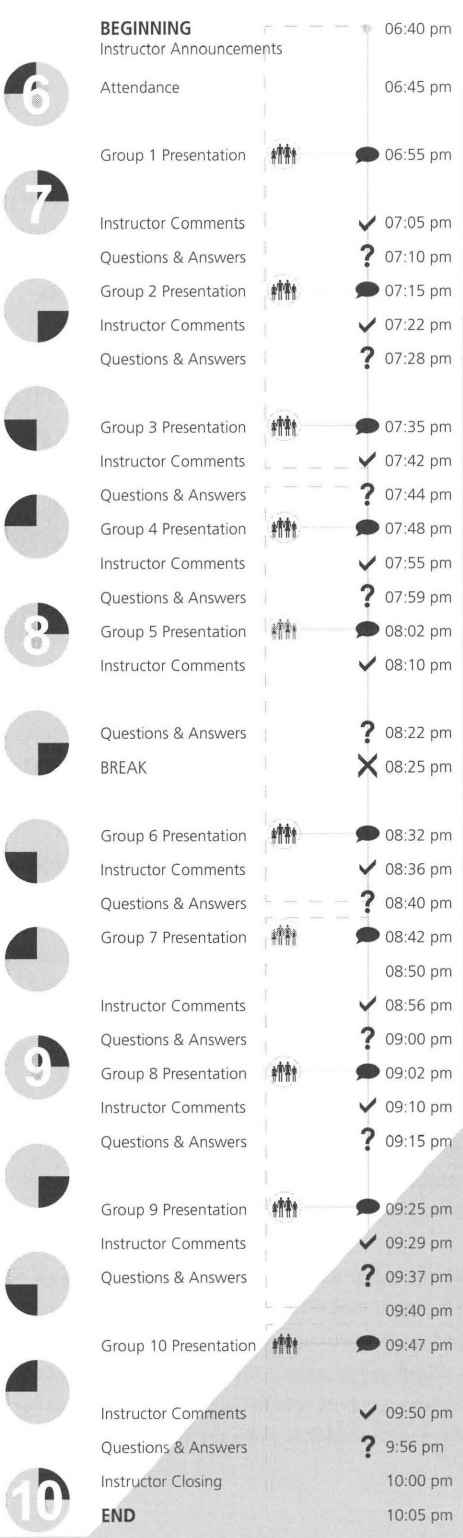
USE OF TIME AND SPACE

The visual mapping and analysis of the use of time (*figure 3*) and space (*figures 4 and 5*) help provide a picture of the interaction that takes place in the observed classroom. In the same way, it assists in demonstrating the importance of action within the learning process. Figure 3 demonstrates how time is structurally used during the observed graduate Design class.

The class starts ten minutes late and ends thirty-five minutes after the scheduled time. In terms of chronemics, or use of time as a message system, this gives information about the instructor's position of authority, where students wait for the class to start and stay late until whenever the class finishes, instead of counting on a fixed schedule. The class is organized in clear blocks; it starts with announcements and attendance taken by the instructor and a short introduction to the topic, followed by ten student group presentations. Each presentation is followed by comments from the instructor and a brief question and answer session, open for the participation of the entire class. In between the student presentations, the class pauses for about ten minutes. At the end of the last presentation, the instructor closes the class with final comments.

The pedagogical choices made by the instructor regarding the structure of the class, created possibilities and constraints for learning (table 1). In addition to the affordances for learning available to students in face of the situation shaped by the instructor, it is also important to comment on the perceptible affordances, that is the affordances perceived by the students, or the ones they chose to make use of, for various reasons, within a larger set of existing possibilities.

The announcements and closing sections can be characterized as a one-way delivery of information (Oliver & Conole, 1999) by the instructor; students mainly listen to the messages and reply with answers that are directed to them individually or to the class as a group. All together, they take twenty minutes out of 3:25 hours. The announcement section sets the stage for what is going to happen in the entire class; this is where students get a big picture of how the



TYPES OF ACTIVITIES

- Presentation (One-way delivery of information)
- Communication (Two-way delivery of information)
- Practice (Hands-on activity)
- Assessment (Feedback on performance)

REMARK:
Group presentations presuppose that the group gathered earlier for practice.

Figure 3 Use of Time

events will unfold. In addition, it also gets the different groups of students ready for their presentations, so they can flow from one to another smoothly. In this way, it is efficient in providing clear goals, which are, according to Laurillard, Stratfold, Luckin, Plowman & Taylor (2000), an important design feature that affords on-task talk, guiding the narrative and promoting the students' own narrative construction. An extract from the announcements section is: a) spoken language —"Did everybody get a copy of tonight's handout?" b) hand and arm movement —"raising paper with right hand above head and shaking it" c) deictic gesture after the hand and arm movement —"pointing to where the handouts are" d) head movement —"looking from one side to the other of the classroom, scanning to see if a student did not get the handout" and e)

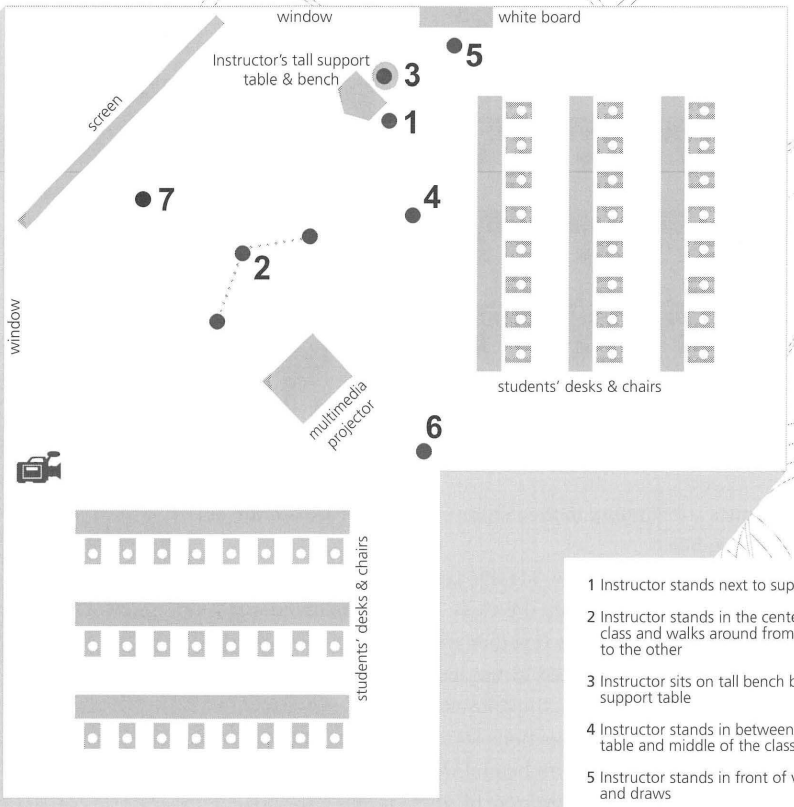


Figure 4 Instructor's Use of Space

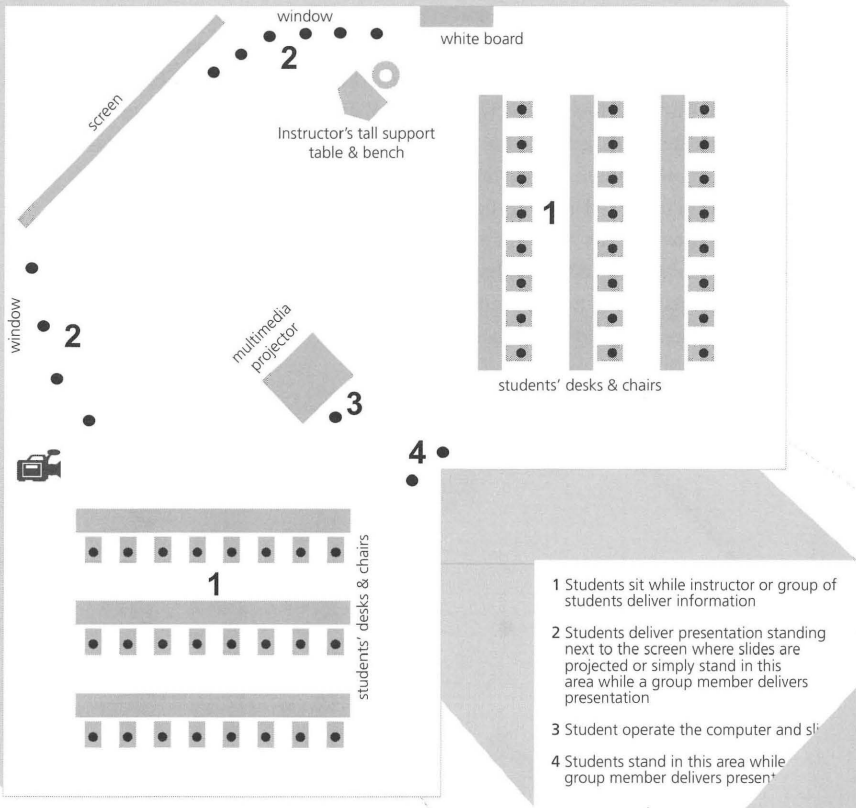


Figure 5 Students' Use of Space

proxemics —"standing in the center of the stage area of the classroom, with social distance."

The closing section, ideally, provides a space for systematization of the concepts viewed during the class. The systematization of the frameworks discussed during the class together with the goal of the presentations, however, were not provided by the instructor. Instead, the instructor made announcements related to the following class.

The presentation sections start with the indication of the deictic sign of the instructor, together with head movement, gaze and body movement. Groups one through ten, take an average of seven minutes to present, totaling 1:06 all together, despite being given only three minutes to present. At the start of each presentation, the lights are turned off, and, then, turned back on at the end. All student groups made use of the classroom's multimedia projector, showing both text, graphic and sometimes this activity can also be classified as one-way

delivery of information with limited affordances for learning, but in this case, the students are the delivers. One benefit of the group presentations, however, is that they presuppose a group interaction prior to the performance. And, in terms of affordances for learning, the group interaction indicates the prospect for hands on activity where the concepts taught on the previous class can be explored within a group, with opportunities for a two-way narrative construction among group members to emerge.

The instructor's comments at the end of each group presentation can be classified as assessment or feedback on performance (Oliver & Conole, 1999). It affords students the opportunity to reflect on aspects of their presentation, what went well and what did not in the application of the analysis frameworks. It also creates a space for asking questions and getting answers, which corresponds

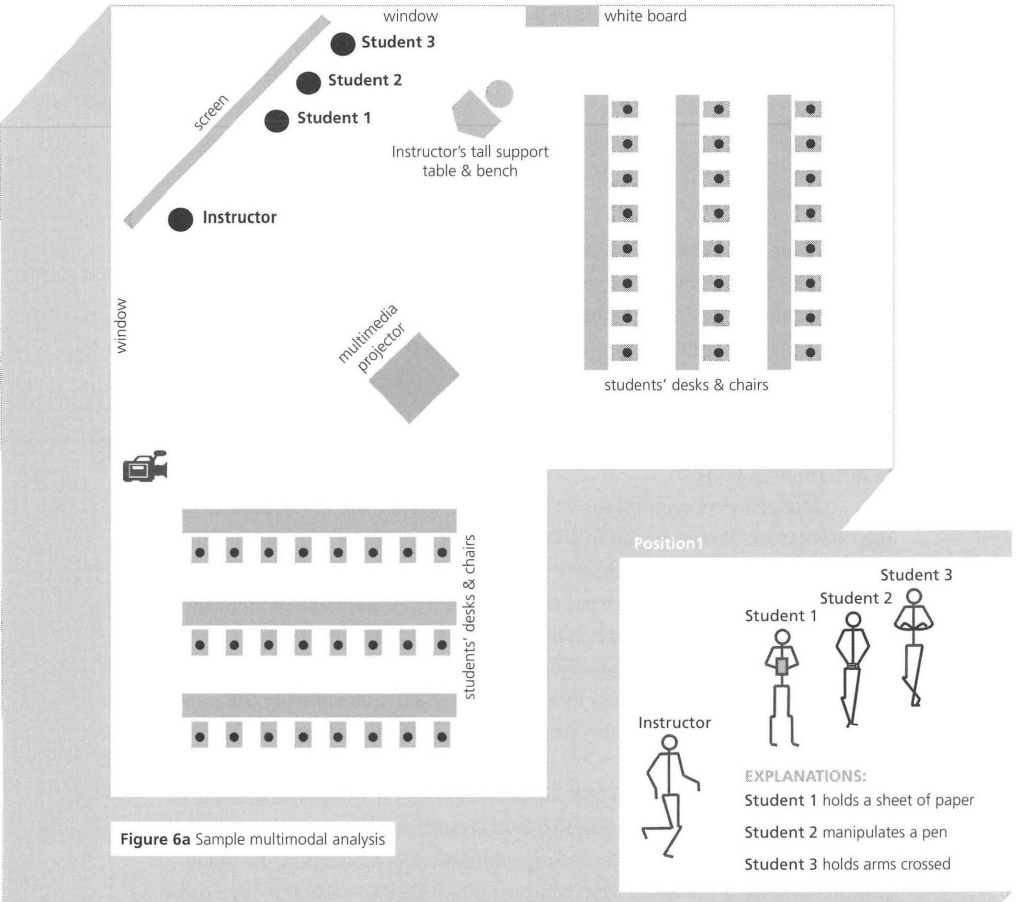


Figure 6a Sample multimodal analysis

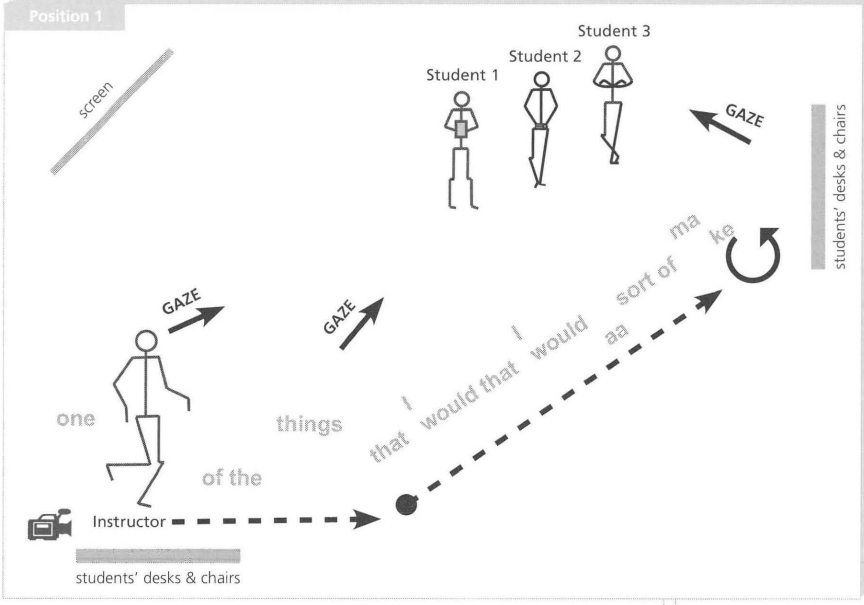


Figure 6b Sample multimodal analysis

to a two-way narrative construction (Oliver & Conole, 1999), with increased affordances for learning. The combined question and answer sections took forty-four minutes out of 3:25 hours. The group sizes ranged between four and five students. Not every student, nevertheless, had a chance to talk during the presentations. During these assessment sections, the instructor highlights both strong and weak points of the presentations. One example of this behavior is seen in the interaction between the instructor and one of the students from team A, described in table 2.

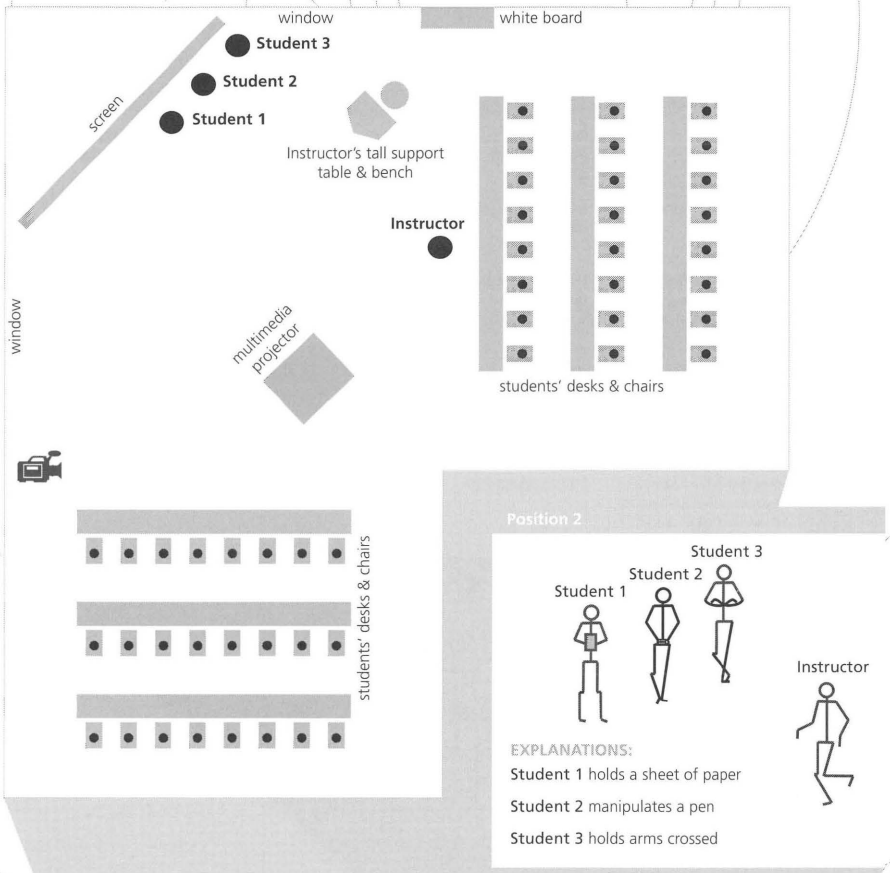
The group presentations vs. discussion class format, as described, takes the information delivery load from the instructor and places it on the students, which can be both good and bad. It can be good in the sense that it, ideally, empowers students to explore concepts and to be responsible to communicate them to a larger group in a professional way. It can also, however, lead to poor comprehension of the concepts explored, since there was no supervision during the exploration phase, and also to a feeling of inadequacy during the public evaluation of a presentation, in case it did not go so well. It certainly put students on the spot.

Considering that the class includes students from different cultural backgrounds and who speak English as a second language, it is important to point to the fact that no international student posed questions or made comments during the discussion sessions. Four US male students and three

US female students made comments and asked questions during the class, and two of these male students were the ones who spoke more frequently. So, the international students only spoke during their group presentations. Another interesting issue is the formation of the groups. There was little mixture of nationalities within the groups. So, seventy percent of the groups were either formed by US students only or international students only. And among the groups formed by only international students, some consisted of students of a single nationality. These behaviors indicate the inefficiency of the selected class format in terms of promoting a two-way narrative construction with the participation of the entire class, and of promoting the integration of students with different cultural backgrounds, once the instructor let the students pick the groups themselves.

In relation to use of space, Figures 4 and 5 illustrate the positions taken by the instructor and students during the class. Looking at the stage area, it is noticeable that the instructor explored the space fluidly, while the students

Figure 6c Sample multimodal analysis



remained at its borders, either near the screen at the corner of the classroom, next to the window, behind the multimedia projector or sitting at the student desks in the "L" shaped classroom.

Among the higher level actions taken during the classroom interaction, the one briefly examined on table 2 and figures 6a, 6b, 6c and 6d, when the instructor gives feedback on student performance, demonstrates how the analysis can be dynamically conducted, either through text or images (*figures 6a, 6b, 6c, 6d and 7*). This higher level action can be subdivided into several intermediate level actions — one of them was pointed out in the analysis in the table and figures just cited, when the instructor walked around the stage area while talking to the students. Among the lower level actions that composed the intermediate and higher level actions examined, one example was the instructor's eye gesture, when he looked upwards, reflecting about what he was saying to the group of students. Among the communicative codes of analysis examined in the example and earlier in the paper, the following are included: spoken language, kinesics, proxemics and chronemics. And among the communicative modes of analysis are: gaze, posture, gesture, hand and arm movement and head movement.

Table 1 Affordances for learning

	One-way information delivery	Two-way narrative construction	Hands-on Practice (in team)	Feedback on Performance
Affordances (Possibilities for action)	Listen, ask, reply, take notes	Communicate, ask, reply, listen, learn	Experiment, explore, learn	Reflect, review, reformulate, plan, learn
Perceptible Affordances - to anyone (Possibilities for action that at least one person notices)	Listen, ask, reply, take notes	Communicate, ask, reply, listen	(Not available to researcher)	Support criticism, clarification
Imperceptible or Hidden Affordances - to most (Possibilities for action that most people do not notice)	Ask, reply	Communicate, ask, reply	(Not available to researcher)	(Not available to researcher)
Selected Affordances - by most (Possibilities for action that most people make use of)	Listen, take notes	Listen	(Not available to researcher)	(Not available to researcher)

Table 2 Interaction between instructor and one team A student

Actor	Action	Verbal Communication	Non-verbal Communication	Space	Time
Instructor	A) Higher level action: instructor feedback on student performance, **A.1)** Intermediate level action: instructor walking around the stage area making comments on the group presentation, **A.1.1)** Lower level actions: spoken language units, and selected gaze, posture and head movement units	A.1.1.1.a) **Communicative code:** Spoken language, **Communicative mode:** Verbal expression: "One"	A.1.1.2.a) **Communicative code:** Kinesics, **Communicative mode:** **Gaze:** instructor looks at the three students being assessed, who are standing near the window, as illustrated in figures 6a and 6b	**Location:** Instructor at position 1, figures 6a and 6b	7:05:10
		Verbal expression: "of the things that I would that I would aah sort of make"	**Gaze:** looking to where he is moving to	**Location:** from the word "one" till "make," the instructor walks to the right side of the stage area, moving towards position 2, illustrated in figures 6c and 6d	7:05:11
		Verbal expression: "a point about"	**Head movement:** instructor turns face to three students being assessed; **Gaze:** instructor gazes at one of the three students	**Location:** position 2	7:05:17
		Verbal expression: "if it were me doing the kind of [class subject] you guys were doing"	**Posture:** instructor poses right hand under elbow and left hand holds chin, legs are semi-open with feet slightly pointing outwards **Eye gesture:** eyes look to ceiling, indicating reflection	**Location:** instructor reaches position 2 and turns his body back towards the three students being assessed	7:05:19
		Verbal expression: "One of the things that I would probably would have added is a North star through it"	**Gaze:** instructor gazes at three students being assessed	**Location:** position 2, towards the 3 students	7:05:26
		Verbal expression: "It is sort of the number of people using the various technologies"	**Gesture:** instructor moves hand from chin to the side, with the palm of the hand upwards and with a curved shape like a shell, representing the quantity he is talking about, and then moves hand back to chin	**Location:** position 2, towards the 3 students	7:05:35
Team A Female Student		**Verbal expression:** "That is something"	**Posture:** student stands with her arms crossed, in a closed and defensive position, plays with left leg as if dancing, indicating she is trying to relax, towards an open leg standing position, indicating she is ready for action	**Location:** Student at position 3	7:05:40
		Verbal expression: "that came through towards the end and we did not have time"	**Gaze:** Looking at the instructor	**Location:** Student at position 3	7:05:42
		Verbal expression: "to put it together"	**Head movement:** rotational head movement, indicating negative	**Location:** Student at position 3	7:05:45
Instructor		**Verbal expression:** "Yep"	**Head movement:** saggital head movement, indicating affirmation	**Location:** position 2 towards the 3 students	7:05:47
		Verbal expression: "it it it sort of fits."	**Gaze:** Looking at student 3, from team A (figure 6d)	**Location:** position 2 towards the 3 students	7:05:48

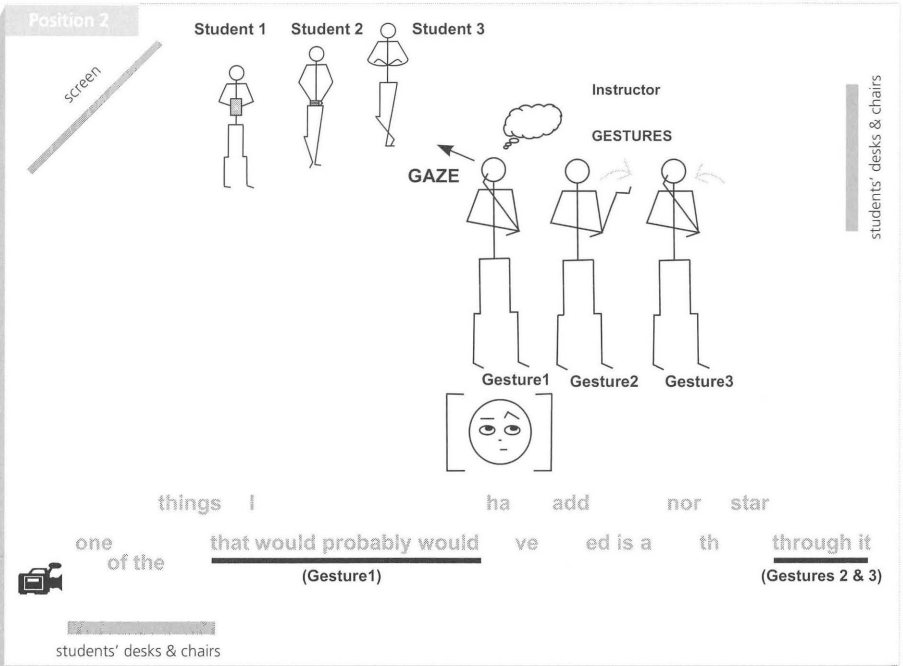


Figure 6d Sample multimodal analysis

In this way, the proposed analysis framework moves from the macro-analysis, through the identification of use of patterns of time and space, to increasing levels of refinement in the analysis, through the identification and examination of the higher, intermediate and lower level actions and the heuristic units of communication, including codes and modes. This process allows both a telescopic and microscopic view of the multimodal classroom and how interactions unfold.

CONCLUSION

The present study sought to expand on an existing multimodal analysis framework, in order to include the classroom affordances for perception and interaction, and to visually map the central role of action to learning. The original framework is characterized by the identification of higher and lower level actions, together with the definition of the heuristic units of analysis or communicative modes. The strategy of analysis moved from the individual analysis of the various communicative modes, to the combined analysis of the interdependent ones, and finally to the analysis of all communicative modes together.

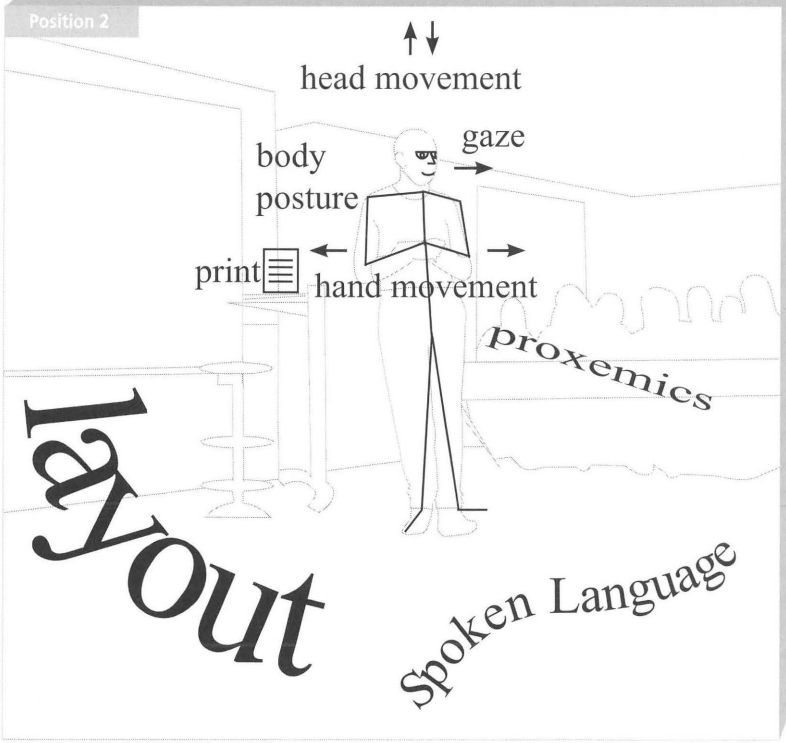


Figure 7 Sample multimodal analysis

The proposed framework moves from the macro-analysis, through the identification of use of time and space, to increasing levels of refinement in the analysis, through the identification, selection and examination of the higher, intermediate and lower level actions and the heuristic units of communication, including codes and modes. The strategy of analysis in the proposed framework uses the macro level phase to identify the major interaction units that need to be explored in the micro level analysis, instead of analyzing all the interaction units. In this way, it makes the analysis more time efficient and adaptable to the researcher's goals within a project.

A video ethnographic study conducted in a graduate Design classroom was used as an illustration for the application of the expanded analytical framework. The process included the visual representation of the various phases of the proposed framework, including: the graphic representation of multimodal analysis across time and space and a table representing all the different levels of analytical units.

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