
Regulation of participatory interaction in university lectures. Co-constructive training proposal based on observational methodology as mixed methods strategy

Regulación de la interacción participativa en clases universitarias expositivas. Propuesta formativa co-constructiva basada en la metodología observacional como estrategia mixed methods

大学说明性课程中参与式互动的规范。基于观察方法作为混合方法策略的共建训练建议

Регулирование интерактивного взаимодействия в университетских лекциях. Предложение совместного конструктивного обучения на основе наблюдательной методологии как стратегии смешанных методов

Héctor Tronchoni
University of Valencia
hector.tronchoni@gmail.com
<http://orcid.org/0000-0003-4693-0185>

Conrad Izquierdo
Autonomous University of Barcelona
conrad.izquierdo@uab.cat
<http://orcid.org/0000-0002-8863-7983>

M^a Teresa Anguera
University of Barcelona
tanguera@ub.edu
<http://orcid.org/0000-0001-7147-2927>

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Abstract

The objective of this article is to share some background and procedural considerations on academic communication modeled by participatory interaction in the co-constructive training framework for teachers. From a case study in a university classroom, the expository-lectures format is analyzed with actors motivated to sustain their dialogical position of role in communicative interaction and facilitate acts of reciprocal help as well as discursive and interactive resources that fulfill a strategic function because they are necessary for the intellectual and autonomous construction of learning. Empirical research is designed as a systematic observation study with an evaluative purpose and that implements the integration of qualitative and quantitative analysis from a «mixed methods» approach. The discussion of the results highlights the flexibility and suitability of the method used both in terms of the nuanced description of the participatory interaction process attempted by the actors and in terms of the formative assessment of the strengths and weaknesses of the expository-lectures observed.

Keywords: Systematic observation of interaction, relational-instructional communication, knowledge construction, higher education, discursive and semiotic strategies.

Resumen

El objetivo de este artículo es compartir algunas consideraciones de fondo y procedimiento sobre la comunicación académica modelada por la interacción participativa en el marco de la formación co-constructiva del profesorado. A partir de un estudio de caso múltiple en aula universitaria se analiza el formato expositivo-magistral con actores motivados a sostener su posición dialógica de rol en la interacción comunicativa y facilitar los actos de ayuda recíproca, recursos discursivos e interactivos que cumplen una función estratégica porque son necesarios para la construcción intelectual y autónoma del aprendizaje. La investigación empírica se diseña como un estudio de observación sistemática con un propósito evaluativo y que implementa la integración de los análisis cualitativos y cuantitativos desde un enfoque *mixed methods*. La discusión de los resultados pone en valor la flexibilidad y la adecuación del método utilizado tanto en el plano de la descripción matizada del proceso de regulación de la interacción participativa intentada por los actores como en el plano de la evaluación formativa de los puntos fuertes y débiles observados.

Palabras Clave: Observación sistemática de la interacción, comunicación relacional-instruccional, construcción del conocimiento, educación superior, estrategias discursivas y semióticas.

概要

本文的目的是在对教师的共建培训框架内分享以参与式互动为模型的学术交流的一些背景及其过程。我们从大学课堂的多个案例研究中分析了说明性-权威模式，其中参与者被鼓励坚持其在交流互动中的对话角色地位，并推动互惠帮助的行为和具有战略功能的话语和互动资源，因为它们是知识与自主学习建构所必需的。该实证研究被设计为具有评估目的的系统观察研究，从混合方法角度整合了定性和定量分析。对结果的讨论中从两方面强调了该方法的灵活性和充分性，一方面为对参与者尝试的参与式互动过程的细致描述方面，另一方面是在对所观察到的说明性讲座的优缺点的形成性评估方面。

关键词: 对互动的系统观察、关系教学交流、知识建构、高等教育、话语和符号学策略。

Аннотация

Цель данной статьи - поделиться некоторыми исходными данными и процедурными соображениями об академической коммуникации, моделируемой партисипативным взаимодействием в рамках ко-конструктивного обучения преподавателей. На примере университетской аудитории анализируется формат докладов-лекций с действующими лицами, мотивированными на поддержание своей диалогической роли в коммуникативном взаимодействии и содействии актам взаимной помощи, а также дискурсивные и интерактивные ресурсы, выполняющие стратегическую функцию, поскольку они необходимы для интеллектуального и автономного построения обучения. Эмпирическое исследование построено как систематическое наблюдательное исследование с оценочной целью, в котором реализована интеграция качественного и количественного анализа на основе подхода «смешанных методов». Обсуждение результатов подчеркивает гибкость и пригодность используемого метода как в плане детального описания процесса партисипативного взаимодействия, который пытались осуществить участники, так и в плане формативной оценки сильных и слабых сторон наблюдаемых докладов-лекций.

Ключевые слова: Систематическое наблюдение за взаимодействием, реляционно-интерактивная коммуникация, формирование знаний, высшее образование, дискурсивные и семиотические стратегии.

Introduction

The study of communication in the classroom relates the teaching and learning processes to the communicative processes in the participatory interaction of the actors. We have conceived the empirical approach to this complex issue as a co-constructive formative evaluation study (Monereo, 2009) based on the systematic observation (Anguera et al., 2001) of a multiple case of expository-masterful instructional communication (from now on CEM) in postgraduate university programs. At a time when it seems that this instructional format is in disuse, a more careful and open look at different contexts of university teaching (Darling, 2017) discovers the functions and diversity of areas of knowledge in which CEM is applied and the concern that teachers share about how to promote a better use of the format (Gatica-Saavedra & Rubí-González, 2021; Mazer & Hess, 2017). We start, therefore, from that need expressed and addressed (Tronchoni, 2019) in the context of the Popular Autonomous University of the State of Puebla-Mexico (UPAEP).

According to the reviews carried out in different areas of instructional communication (Houser & Hosek, 2018; Prados & Cubero, 2005; Ruiz et al., 2010), the driving idea of the CEM study at UPAEP, started in 2015, was that of proposing and justifying the viability of a collaborative dialogical turn (vs. procedural interactions in parallel) in the way of preparing and interpreting this teaching format.

In tune with the Vygotskian perspective (Coll, 1991; Wertsch, 1988), we assume (Tronchoni, 2019) that the dialogical turn in the way of conceiving and implementing participatory interaction in the instructional context of the CEM activity must be reflected in the ways of organizing and conducting the exhibition process from both poles of interaction. From the position of an expert, the dialogic turn involves visualizing the help that is offered to the apprentices so that they can make sense of the reception of the selected contents, which are the object of the exposition. We also assume that so-

cio-educational help through the activation of interactive-discursive strategies can be analyzed as a multilevel process of sequential links between interactive acts that fulfill different functions in the guided elaboration of the transmission-reception expository of scientific knowledge.

In accordance with the approach that we have just summarized, and the necessary articulation between the object of the research and the methodological proposal that is adopted, this study highlights the potential of the systematic observation method to obtain valid, reliable and relevant qualitative interactive data that can be quantitatively analyzed with robust statistical techniques (Anguera et al., 2021; Portell et al., 2015). The methodological choice of this study places us in the paradigm *mixed methods* (Izquierdo & Anguera, 2021).

Indeed, the proposal by Creswell & Plano Clark (2007:7) 'connecting two datasets by having one build on the other' fits and is inherent to the same process of systematic observation. Hence, we highlight what Symonds and Gorard (2010) describe as the elements of any empirical research, and among which we point out the transformation of data of one type into others, the weight we give them in the research process, and the applied timing, which are even more relevant when approaching a case study. This important step is the methodological aspect that we want to highlight since it complements and highlights the applicative potential of systematic observation in single case studies (Belza et al., 2019; García et al., 1990; Herrán, 2014; Lapresa et al., 2020; Pantoja et al., 2014) that meet the quality criteria indicated by Gerring (2007). Finally, the systematic observation instrument built to record the CEM sessions from a constructivist sociocultural approach to learning in the field of instruction (Tronchoni et al., 2018), is aligned with a vision of communication based on a pragmatic analysis, realistic and systematic of the interactive nature of cooperative relationships that shape academic discourse in context (Watzlawick et al., 1981; van Dijk, 1997, 2000). The dialogic principle of the expository discourse of the expert, understood as the search for the active response of the other (Bajtín, 1997), is transformed into a mechanism of change by operating through participatory interaction. This includes the joint action of the active role of the listeners-students (Barker, 1971; Duncan, 1973; Poyatos, 1983) with the regulatory interventions of the competence distance that the teacher produces in the position of main speaker (Bruner, 1978 ; Coll & Onrubia, 2001; Hyland, 2005; Prados & Cubero, 2005).

Regarding the evaluative analysis of the qualitative observational data obtained, it must provide the answers we seek to the channeling questions, which are voiced by the participants, of the training work that we propose to carry out (Rowland, 2005): how are we doing it regarding the position and communicative reciprocity? And what are we sharing as facilitators of the intellectual task?

The data analysis and the discussion of results that we present in the following sections correspond to one of the cases studied in the CEM project of the UPAEP.

Method

Participants and scene

The observed situation is an expository lesson given in the Master in Mathematics Education of the UPAEP. As can be seen in Figure 1, the mathematics class is taught in a traditional multimedia classroom.

The participants are the teacher, who we name MAT, and the students. MAT, at the time of observation, is 40 years old and specializes in Mathematical Sciences. Your participation is voluntary and you have been duly informed of the evaluative purpose of the observation. The MAT is a motivated teacher, willing to improve and enhance their expository practice based on the evaluation carried out.

On the day of the observation, nine students attended: three women and six men, who are practicing teachers at the non-university level. Their age range is from 26 to 53 years old and as for their origin, they are originally from various urban and semi-urban regions of the State of Puebla. In addition to participating as students attending the class that MAT teaches, their voice has been incorporated when evaluating the CEM format. The informed consent of the participants was obtained.

Figure 1

Participants in the lecture class session



Observation instrument

The observation instrument *ad hoc*, called LUniMex-2017 (Tronchoni et al., 2018), combines field format with category systems that meet the conditions of completeness and mutual exclusivity. According to the conceptualization made in the previous section, the scheme used to code the observed behavioral events is the one presented in Table 1.

Table 1

Observation instrument LUniMex-2017

Macrodimension 1: organizing contributions to the interaction		
Dimensions	Subdimensions and Category systems	Codes
Primary qualities	Sequential order	[000]
	Time	[hh:mm:ss]
	Exchange duration in seconds	[00:00]
Scene	Who-to-whom	QaQ
	Teacher-Group/Group-Teacher	DG/GD
	Teacher-Students/Students-Teacher	DE/ED
	Teacher-MaleStudent/MaleStudent-Teacher	DEo/EoD
	Teacher-FemStudent/FemStudent-Teacher	DEa/EaD
	Role in the speaker's use of the word	RUP
	Main speaker	HA
	Secondary speaker	HI
	Active listener	OA
	Listener (instrumental)	O
	Exchange mode	MIN
	Proposal-response mode	MPR
	Positive self-replication	URPP
	Negative self-replication	URPN
	Positive alter-replication	ARPP
Negative alter-replication	ARPN	
Communicative acts of the participants	Basic verbal acts	ABA
	Request	PE
	Give	DA
	Show	MO
	Ignore or reject	IR
	Emitter-receiver adjustment task	TAJ
	Share information	CI
	Share opinion	CO
	Share homework	CD

Macrodimension 1: organizing contributions to the interaction		
Dimensions	Subdimensions and Category systems	Codes
	Share instruction	CN
	Share experience	CE
	Share attitude	CA
	Share courtesy	CC
Macrodimension 2: regulation of participation in the construction of knowledge		
Dimensions	Subdimensions and Category systems	Codes
Communication-learning problem	Support strategies that control the objective to establish bridges	EEP
	Previous knowledge of the social framework	CIN
	Knowledge shared in class	CCO
	Individual experience of the social framework	EIN
	Shared experience in class	ECO
	Support strategies that control the objective of attributing meaning to the master class	EAS
	Current content or procedures	CEC
	Use of the 1st person plural	UPL
	Formulation of question followed by response	PRE
	Incorporation of contributions	ICO
	Support strategies controlling the objective of advance in the content elaboration process of the exhibition	ELA
	Recapitulation	REC
	Summary	RES
	Synthesis	SIN
Relational bond	Categorization or labeling	CAT
	Reelaboration	REE
	Change of referential perspective	CAM
	Sociocognitive proximity (presence) / distancing (absence) regulation and emotional heat (presence) / cold (absence)	RPS/RCE
	Proximal-Warm Exchange	IPC
	Proximal-Cold Exchange	IPF

Macrodimension 2: regulation of participation in the construction of knowledge		
Dimensions	Subdimensions and Category systems	Codes
	Distant-Warm Exchange	IDC
	Distant-Cold Exchange	IDF
	Neutral Exchange	INE

Recording and analysis instruments

The video recording of the CEM session was encoded using the free LINCE program (Gabin et al., 2012), and according to the observation instrument. The data obtained are type IV (Bakeman, 1978), although for some analysis they were transformed into type II data (concurrent and event-base).

The analysis programs used were the following free programs: GSEQ5 (Bakeman & Quera, 2011) for the calculation of agreement and the lag sequential analysis, HOISAN (Hernández-Mendo et al., 2012) for the analysis of polar coordinates, and (Rodríguez-Medina et al., 2019) to graph the vectors of the polar coordinates.

Procedure

The observational design implemented (Anguera et al., 2001) is idiographic, punctual and multidimensional: I/P/M. The observation unit (I) is the interactive behavior of the teacher giving an expository lesson of a magisterial court; the data matrix comes from the observation of a session with intrasessional follow-up (P), and the observation instrument has been developed incorporating different dimensions of the object of observation (M).

Regarding how to proceed to guarantee the reliability of the data, the video cameras were kept in the same place and in the same position. Regarding how to proceed to guarantee the reliability of the data, the video cameras were kept in the same place and in the same position. The MAT session, like the rest of the sessions, were recorded from start to finish. The unit for recording the interactive behavior of MAT was the oral clause (visible-audible), without condition of size, with social meaning and the consequent behavior of the students limited by the continuity of the teacher's intervention if he continues to hold his turn, or for the start of a new intervention if the teacher gave up his turn as an expert.

We proceeded to guarantee the consistency in the recording of the same observer and a quality control of the data was carried out by calculating the coefficient of agreement of Cohen (1960), obtaining values $kappa > .90$.

Results

The objective of finding regularities in the oral exchanges that describe the orderly evolution of the dialogic links of the observed CEM has been materialized by subjecting the matrix of qualitative data to lag sequential analysis and a subsequent analysis of polar coordinates. This important step in the quantitative treatment of qualitative data identifies the *mixed methods* dimension of systematic observation.

Lag sequential analysis

Sequential lag analysis is a powerful analytical technique proposed by Bakeman (1978) that allows the detection of regularities from categorical data that are not due to the effect of chance. This analysis technique (Bakeman & Quera, 2011) has been used in multiple studies carried out in the last quarter of the century, both in the educational field (Escolano et al., 2019; García-Fariña et al., 2018; Lapresa et al., 2020) as in others, and requires proposing one or several criteria behaviors (the one/s that, by hypothesis, are supposed to generate a pattern of behavior), and one or more conditioned behaviors (the one/s that we want know if they present a statistical relationship of association with the criterion behavior).

Table 2 shows the criterion behaviors and the conditioned behaviors considered, and presents the significant adjusted residuals obtained using the GSEQ5 program, indicating the level of significance.

According to the lag sequential analysis carried out, the interactive current of behavior observed and encoded in the MAT teacher's CEM appears ordered in sequences named as dialogic links. A dialogic link is a sequential pattern of behaviors that comprises more than two codes of our observation instrument, and that ends conventionally according to the existing technical rules for the completion of a pattern of conduct (Anguera et al., 2021).

Table 2 lists the dialogic links that, in addition, are significant and provide a view of the sequential structure of communication in participatory interaction referring to exchange segments that perform cooperation functions related to the maintenance of the exchanges between principal-expert speaker/active listeners (links [1]-[3]), and the regulation of the construction of the learning problem through the instrumental and socio-affective reduction of the competence distance (links [4]-[7]).

Table 2

Significant adjusted residuals corresponding to lag sequential analysis

Dialogical link of the direction of action with intra/inter turn alternation: QaQ [1]												
Criterion behavior	Conditioned behaviors	Level of Significance	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
DA	ALL	.01	DG	ED	DG	ED	DG	ED	DG	ED	DG	ED
			7.86	5.39	7.08	4.77	6.84	5.25	7.84	5.41	7.51	5.07
		.01	DG	GD	DG	GD	DG		DG	GD	DG	GD
			7.86	2.92	7.08	3.51	6.84	∅	7.84	2.58	7.51	3.04

Dialogical link between the direction of the action and the role in the use of the word [2]												
DA	HA,HI,OA,O	.01	HA	OA	HA	OA	HA	OA	HA	OA	HA	OA
			3.72	4.72	3.86	4.14	4.69	4.3	3.9	4.07	3.81	3.82
Dialogical link of the direction of the action with the score of the exchange mode [3]												
DA	MPR,ARPP, ARPN,URPP, URPN	.01	∅	MPR	∅	MPR	∅	MPR	∅	MPR	∅	MPR
				2.64		4.61		2.36		2.1		2.42
Dialogical link between the direction of the action and the content to be shared [4]												
PE	CI,CO, CD,CN,CE CA,CC	.05	CD	CD	CD	CD	CD	∅	∅	∅	∅	∅
			2.66	2.04	2.04	2.03	2.06					
Enlace dialógico de la dirección de la acción con el apoyo integrativo [5]												
Criterion behavior	Conditioned behavior	Level of Significance	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
PE	IPC,IPF, IDC,IDF,INE	.05	IDC	IDC	IDC	IDC	IDC	IDC	∅	IDC	∅	IDC
			3.52	4.16	2.44	3.81	2.06	2.70		2.08		2.75
Dialogical link of the shared content with the support strategies [6]												
CI		.05	PRE	PRE	PRE	PRE	PRE	PRE	∅	∅	∅	∅
			3.49	3.33	2.75	2	2.33	2.30				
	CIN,CCO, EIN,ECO,CEC, UPL,PRE, ICO,REC, RES,SIN, CATREE,CAM	.05	UPL	UPL	UPL	UPL	UPL	∅	∅	∅	∅	∅
			4.85	4.06	3.40	2.71	2.00					
CD		.1	CCO	CCO	CCO	CCO	CCO	CCO	CCO	CCO	CCO	∅
			5.8	5.8	5.94	6.08	6.24	6.41	6.59	4.94	3.1	
Dialogical link between the control of instrumental support objectives and the regulation of sociocognitive distance [7]												
CEC		.05	IDC	IDC	IDC	IDC	IDC	IDC	IDC	IDC	IDC	IDC
			3.54	3.15	3.06	2.96	2.85	2.86	2.45	2.04	2.04	2.05
	IPC,IPF IDC, IDF,INE		IPF	IPF	∅	∅	∅	∅	∅	∅	∅	∅
PRE		.05										
			2.18	2.97								

Note. The successive lags considered in the lag sequential analysis are expressed respectively by R1, R2, R3, R4, R5, R6, R7, R8, R9 and R10. Likewise, the symbol ∅ (empty set) indicates obtaining null values of fitted residuals.

Polar coordinate analysis

The analysis of polar coordinates is an analytical technique proposed by Sackett (1980) that allows building a map that shows the statistical relationships of association that exist between the different codes of conduct and, specifically, between what is considered central or focal and all those others - conditioned behaviors - with which we want to know if there is a relationship and of what nature and intensity these relationships are. It is a very powerful analysis technique, developed later (Anguera, 1997), and widely used, both in the educational field (Escolano et al., 2019; Lapresa et al., 2020) and in others.

It is based on the concepts of prospectivity and retrospectivity, and applies the parameter Z_{sum} proposed by Cochran (1954), which greatly reduces the calculations to obtain the parameters of the vectors. There are as many vectors as there are conditioned behaviors. The angle of the vector, and consequently the quadrant in which it is found, indicates the nature of the relationship between the focal behavior and the conditioned behavior, and the length of the vector indicates its intensity.

To facilitate the interpretation of the vectors, we include Table 3, where the type of relationships between the focal behavior and a conditioned behavior in each quadrant are specified.

Table 3

Meaning of the vectors depending on the quadrant in which they are found

Quadrant	Z_{sum} Prospective sign	Z_{sum} Retrospective sign	Interpretive Meaning
I	+	+	Focal and conditioned behavior activate each other.
II	-	+	Focal behavior inhibits the conditioned, and the latter activates the focal.
III	-	-	Focal and conditioned behavior inhibit each other.
IV	+	-	Focal behavior activates the conditioned, and the latter inhibits the focal.

In Table 4 and Figure 2 we include and represent the parameters corresponding to the significant vectors when Give (DA) is the focal behavior and all those that make up the macrodimension Regulation of Participation in the Construction of Knowledge (RPCC) as conditional. In parallel, Table 5 and Figure 3 respectively present the parameters and representation of significant vectors when Share Information (CI) is the focal behavior and all categories of the RPCC macrodimension are conditioned.

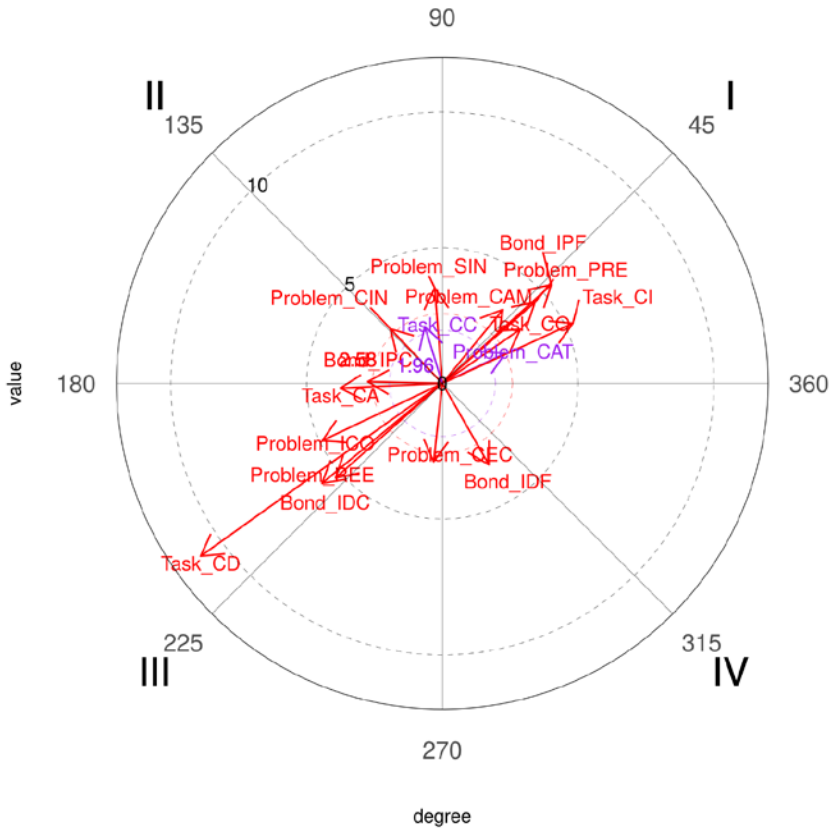
Table 4

Parameters corresponding to the analysis of polar coordinates, where DA is the focal behavior (only those corresponding to significant and highly significant vectors are included, specified by () and (**), respectively, in the length of the vectors)*

Category	Quadrant	Prospective P.	Retrospective P.	Length	Angle
Task_CI	I	4.8	2.21	5.29 (**)	24.72
Task_CO		2.88	2	3.5 (**)	34.78
Problem_PRE		3.41	2.98	4.53 (**)	41.2
Problem_CAT		2.31	1.1	2.56 (*)	25.57
Problem_CAM		2.23	2.72	3.51 (**)	50.64
Bond_IPF		4.01	3.63	5.41 (**)	42.18
Task_CC	II	-.64	2.09	2.19 (*)	107.16
Problem_CIN		-1.91	2.01	2.77 (**)	133.59
Problem_SIN		-.28	3.51	3.53 (**)	94.6
Bond_IPC		-2.75	.06	2.75 (**)	178.67
Task_CD	III	-8.9	-6.36	10.94 (**)	215.55
Task_CA		-3.76	-.17	3.76 (**)	182.67
Problem_CEC		-.32	-2.88	2.9 (**)	263.66
Problem_ICO		-4.41	-2.1	4.89 (**)	205.49
Problem_REE		-3.93	-3.48	5.25 (**)	221.51
Bond_IDC		-4.43	-3.68	5.76 (**)	219.7
Bond_IDF	IV	1.71	-2.99	3.45 (**)	299.78

Figure 2

Significant vectors corresponding to the analysis of polar coordinates, DA being the focal behavior



The vectors obtained when considering DA as focal behavior (Table 4) indicate that DA is mutually activated with the CI, CO categories of the Task dimension, with the PRE, CAT, CAM categories of the Problem dimension, and with the IPF category of the Link dimension. Furthermore, DA is mutually inhibited with the CD and CA categories of the Task dimension, with the CEC, ICO and REE categories of the Problem dimension, and with the IDC category of the Bond dimension. Asymmetrically, DA inhibits the CC categories (Task dimension), CIN and SIN (Problem dimension) and the IPC category (Bond dimension), while all of them activate it. And finally, DA activates the IDF category (Bond dimension), being inhibited by it.

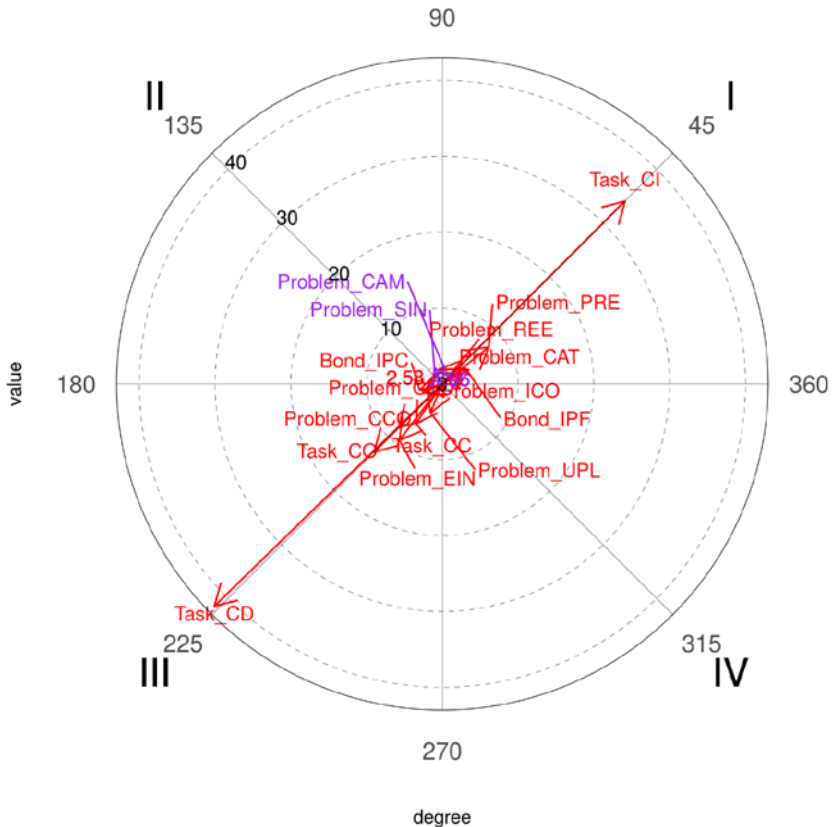
Table 5

Parameters corresponding to the analysis of polar coordinates, with CI being the focal behavior (only those corresponding to significant and highly significant vectors are included, specified by (*) and (**), respectively, in the length of the vectors)

Category	Quadrant	Prospective P.	Retrospective P.	Length	Angle
Task_CI	I	24.1	24.1	34.08 (**)	45
Problem_PRE		6.13	4.85	7.82 (**)	38.36
Problem_ICO		2.42	1.44	2.82 (**)	30.71
Problem_CAT		3.49	1.87	3.96 (**)	28.24
Problem_REE		2.52	3.05	3.96 (**)	50.47
Problem_CAM		.18	2.28	2.29 (*)	85.61
Bond_IPF		3.03	2.07	3.67 (**)	34.42
Problem_SIN	II	-1.06	2.13	2.38 (*)	116.58
Task_CO	III	-8.99	-8.98	12.7 (**)	224.96
Task_CD		-30.09	-29.31	42.01 (**)	224.25
Task_CC		-3.49	-5.24	6.29 (**)	236.32
Problem_CCO		-5.78	-5.77	8.17 (**)	224.93
Problem_EIN		-5.66	-7.41	9.33 (**)	232.64
Problem_CEC		-2.56	-1.18	2.82 (**)	204.73
Problem_UPL		-1.58	-3.81	4.13 (**)	247.56
Bond_IPC		-3	-.82	3.11 (**)	195.35

Figure 3

Significant vectors corresponding to the polar coordinate analysis, with CI being the focal behavior. Due to highly heterogeneous vector length values, shorter vectors are not well distinguished



The vectors obtained when considering CI as focal behavior (Table 5) indicate that CI (Task dimension) is self-activating, mutually activating with the PRE, ICO, CAT, REE, CAM categories of the Problem dimension, and with the IPF category of the Bond dimension. Furthermore, CI is mutually inhibited by the CO, CC and CD categories of the Task dimension, with the CCO, EIN, CEC and UPL categories of the Problem dimension, and with the IPC category of the Bond dimension. Asymmetrically, CI inhibits the SIN category (Problem dimension), while SIN activates CI.

Discussion y Conclusions

From the point of view of the dialogical and constructivist turn that the participants pursue with their participatory interaction, we understand that the links whose probabilities significantly exceed those expected must be interpreted as prospective patterns that represent events of interactive behavior with sequential presence differentiated by the number of significant lag transitions. These links, which characterize the

case analyzed, have to answer the double question that frames the specific questions addressed with a training purpose: how do they do it? and what do they share?

On the other hand, the fact that the regularities found play a pertinent and relevant role in the fluid and committed execution of the CEM, is the aspect to be determined with the involvement of the same participants (teacher and students) in their corrective/optimizing assessment of the recorded session from the analyzed data. To guide the functional assessment of dialogic links, we have the theoretical model of active attention of listeners (Barker, 1971; Duncan, 1973; Poyatos, 1983), involved in acts of direction, which involve reciprocity, and in the activation of the informative cycle that gives academic content to the ways of presenting and facilitating the shared intellectual construction of the CEM.

Thus, the results presented from the MAT case (Tables 2, 4 and 5) provide us with the sequential dialogical links, components and influencing relationships, which characterize the strengths and weaknesses of the communication-learning process in the attempted participatory interaction.

Regarding how they do it, we highlight:

1. Conducting the lecture exposition when the group is in the GIVE state (Table 2, [1]) and followed by the “who-to-whom” behavior describes the probability that different options for choosing the recipient will constitute cycles of participatory interaction [DAR0-DG_{odd}/ED_{even} from R1 to R10; DAR0-DG_{odd} with \emptyset R6/GD_{even} from R1 to R10]. Aspect consistent with the principle of otherness (talking to the other).
2. Given the GIVE state (Table 2, [2]) it is very likely to be able to observe that it is followed by active attention maintenance behaviors [DAR0-HA_{odd}/OA_{even} from R1 to R10], an aspect linked to the *flow* experience.
3. The GIVE state (Table 2, [3]) followed by the exchange modes has revealed a pattern that combines random odd delays with even delays of proposal-response mode behavior [DAR0- \emptyset _{odd}/MPR_{even} of R1 to R10]. The fact that this code has been recorded more times than expected may indicate the pressure put on the session to pass on as much information as possible without taking advantage of the opportunities for replication (thoughtful or critical) beyond expectations.

Regarding the question what do they share, we select:

4. The dialogical conduct of the exposition of the lesson, when the group is in a REQUEST state (Table 2, [4]) and is followed by the category of sharing duties (CD), reveals that the participants assume the obligation to propose and carry out exercises as a characteristic aspect of the MAT class [PER0-CD from R1 to R5]. Surely this aspect can not be omitted when evaluating the commitment to the academic task they carry out. Another thing is the assessment that the participants (teacher and students) can make of the burden of obligations within the session and/or post-session in the experience of staying committed to the task and its possible impact on the experience of fluency.
5. In the REQUEST state (Table 2, [5]) the consequent lagged behavior of integrative support that manifests itself is that of a distant exchange at the level of cognitive aid (the aid reinforces the cognitive autonomy of the recipient) and warm in the way to support the recipient (recipient or not of the exchange). This new pro-

longed state of interactive behavior [PER0-IDC from R1 to R10 with \emptyset of R7, R9] is key to driving the dialogical turn and deepening interpersonal communication skills.

6. In the state of sharing CI (information) or CD (duty) (Table 2b, [6]), the cognitive aid behaviors that follow form support links based on (i) the formulation of questions (PRE), when it comes to make sense of the expansion of information [CIR0-PRE from R1 to R6], and (ii) to the use of inclusive expressions (UPL) [CDR0-UPL from R1 to R5], or (iii) to the memory of what was previously shared (CCO) [CDR0-CCO from R1 to R9], when it comes to adjusting homework. The presence of these two patterns of intellectual aid may indicate that the development of the lesson has moved in the zone of involving students in the exercise (homework) that is proposed to them. This aspect that characterizes the observed session leads us to pose the problem of the suitability of a communicative format in accordance with the instructional objectives pursued. Is it appropriate to combine the lecture format with the practice format for procedural training?
7. The state of giving meaning to the development of content through strategies that anticipate the deployment of content to be followed (CEC) or through the direct or indirect use of questions with their respective answers (PRE) (Table 2, [7]), is followed by two new non-concurrent differentiated states of socio-affective regulation. The CEC instrumental strategy is offered and shared by showing warmth while reinforcing the cognitive experience of being in a position to take, receive or perceive what is being given or asked for [CECR0-IDC from R1 to R10]. With the PRE instrumental strategy, the cognitive distance is shortened since the answers clarify the anticipated doubts or uncertainties about the possible difficulties that may arise, but signs of emotional coldness are shared or the signs of warmth are difficult to identify [PRER0-IPF de R1 to R2]. These socio-affective instrumental patterns describe transitions of varying length.
8. The mutually excitatory relationship DA++PRE (Table 4) can be linked with the intention of giving meaning to the burden of sharing the different categories of content by means of generating questions that demand internal or external response from listeners.
9. While, on the one hand, we find that the inhibitory relationship of the DA-ICO dialogical link (Table 4) restricts the probability that the contributions of the students are incorporated into the contributions of the teacher, on the other hand, the effect of CI on ICO (Table 5) is positive. We can infer, therefore, that the adjustment of the informative contents occurs through some form of *feedback* that the teacher facilitates to the students for their intellectual self-regulation.
10. The elaboration of contents (CAT and CAM) is activated both by the communicative act of DA and by the content of the adjustment when it belongs to the CI category: DA++CAM (Table 4) and CI+CAT (Table 5).

In view of the commented results, the MAT case offers a learning communication pattern that balances the orientation of the students' intellectual work between favoring the practice of the contents, an activity typical of the mathematics laboratory, and the reflection and elaboration of the same. This delicate balance complicates the development of the CEM as evidenced by the deficit of dialogical links that impulse reflection and criticism through the different modalities of the replication process (Table 1). However, in terms of incorporating active monitoring of signal traffic offered by listen-

ers, the teacher favors the self-regulation of students by incorporating the behavior of listeners in the contributions he promotes. In this sense, the PRE strategy fulfills the shared purpose, by both poles of communication, of facilitating the scaffolding of meaningful learning through participatory interaction (vs. rote learning-monological communication).

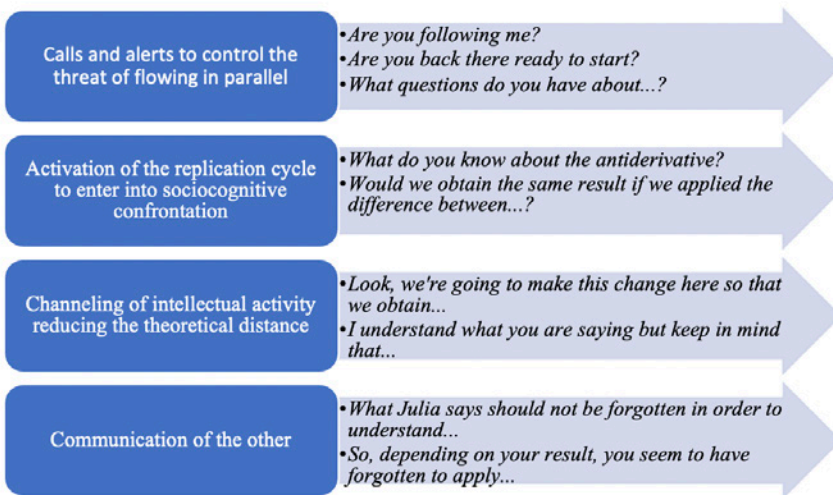
The evaluative objective of observing the regulation of participatory interaction in the MAT case, is specified in a co-constructive formative proposal (Monereo, 2009) introducing the teacher to a varied and specific use of interactive and discursive resources (Figure 4) at different strategic moments of the exhibition, on the two fundamental issues observed:

How they have externalized the dialogic activity through participatory interaction: maintaining the accreditation of valid interlocutors, addressing the teacher to the group in some moments, and to private students, in others (1); activating the role of a secondary speaker (2) through questions; and dynamizing the negotiation of knowledge in the form of self-replicas on the current content shared, and alter-replicas on the current content shared by students (3).

The support strategies have fed back the joint realization of the instructional objectives of the CEM are: the close exchange in the plane of cognitive help (5); the state of sharing information (CI) or homework (CD) (6) based on experiences lived in class (ECO); the connection with the previous knowledge (CIN) and the recapitulation (REC) are resources used to relate what is already known with the new contents and advance in its progressive elaboration; convergence in experiential content (CE) and opinion (CO); and the incorporation of contributions (ICO) related to the thematic moment (9).

Figure 4

Some regulatory resources of participatory interaction in the MAT case that can be reflected in order to deepen the meaning of its use and discover alternatives and nuances in the modes of production as socio-constructivist instructional communication strategies



In summary, the regulation of participatory interaction in the MAT case can be enhanced through a training proposal that includes an improvement plan that incor-

porates the process of connecting-giving meaning-elaborating the contents (Coll & Onrubia, 2001; Prados & Cubero, 2005) in the preparation and execution of the interactive oral presentation of the teacher. This powerful change in the conception of the CEM format must be supported by the academic culture of the university, it must also incorporate the conditions of the scientific domain of the teaching material, as well as the personal conditions of the professor and students, without forgetting other circumstances present in the CEM sessions (Breen et al., 2018). The *mixed methods* approach inherent to systematic observation has made it possible to base the qualitative assessment of EMF in the MAT case on a robust quantitative analysis of the data that describe in detail the pragmatic meaning of the phenomenon studied. Consequently, the research carried out can be reviewed and used in new research by the scientific community interested in the subject. The considerations provided underline the transformative potential of the conceptual-methodological approach followed.

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