STOCHASTIC MODEL G IN THE INFORMATION THEORY OF INSTRUCTION FOR CALCULUS OF THE ENTROPY OF DIDACTIC CREATIVE INTERACTION

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ABSTRACT

The introduction part describes STOCHASTIC MODEL **G** in the context of the INFORMATION THEORY OF INSTRUCTION. It begins with a consideration of the STOCHASTIC MODEL **G**, followed by an informational analysis of the instruction process. It develops the concept of **G** OPERATORS and **G** PROGRAMMING, by which the fundamental structure of the **DIDACTIC MESSAGE** is made clear. There are also evaluations of the possibility for decoding the **DIDACTIC MESAGE** by the ***creative*** processing of the transformation matrix, which result from decoding of the elements of this fundamental structure.

In the second part is calculus didactic interaction entropy creative conditioned of informative and formative interactions. The second part addresses the quantifying criteria for the instructors feedback.

The third part demonstrates the Entropy of Didactic Creative interaction.

The conclusions draw attention to the modes in which the study contributes to the information base of **INSTRUCTION THEORY.** The bibliography is selective, being limited to works related specifically to **STOCHASTIC MODEL *G*.**

1.INTRODUCTION

Its known from precedent paper [9]/1-15, the existence of **G operators as decoder mechanisms of didactic messages** also its importance from the 60th years [9]/1.

The insufficiency or the total absence of didactic devices for using the **didactic messages** made the necessity of a special preoccupation in this direction [9]/4,5,6,8.

After 1971 the researches in this field were oriented especially on theoretical domain by the contributions on the **theory of informational instruction** [9]/10-15.

In paper [9]/14, was calculated the **didactic informative interaction entropy H(E,C) = H(E) + H(C).**

In the paper [9]/15, was calculated the **entropy of C events** for decoder of knowledge, conditioned by **E events of decoder of explicative elements:**

$$H(C\vdots E) = -\sum_{j=1}^{3} p_{1j\cdot} \sum_{q=1}^{3} \sum_{w=1}^{3} p_{2q:1w} .\log p_{2q:1w}))) \qquad (1)$$

In the present paper we will calculate **the entropy of A events of creativity manifestation** conditioned by the **C and E events**, also by the **didactic, informative, formative, creative and concomitant interactions entropy**.

2. THE CREATIVE DIDACTIC INTERACTION ENTROPY CONDITIONED BY THE INFORMATIVE AND FORMATIVE INTERACTIONS

After the debate of **instructor** message the **trained** has a reaction by **feedback**. Like we saw since now, the **didactic message** in its specific structure contained the **explicative elements** and the **knowledge**. The trained recognize this element every time, with its probabilities. In function of his creativity, every trained formulate one answer message, from where the **instructor**, if he has sufficient experience, can decoding some transactions which reflect the next:

- The capacity of **the trained** to formulate **methods**. By other hand, the instructor have appreciate the knowledge of trained for his inventively to understand the new explicative elements in the order with the old explicative elements; e_{31} transition.

- The capacity of **trained to reformulate** the **theory**. The capacity of trained to reformulate the old known in order of new knowledge, $\mathbf{e}_{32}$ transition.

- **Creativity** or the capacity of the trained to formulate hypotheses. The capacity of trained to correlate the new knowledge with the old knows, $\mathbf{e}_{33}$ transition.

- The decoder of a creative feedback presents a high difficulty level, because it isn't only a knowledge accumulation, is the product of a superior intelligence.

A creative message represents three plains of decoders:

1. EXPLICATIONS plain;
2. The model of ABSTRACT KNOWLEGDE plain;
3. The plain of structures which reflects the creativity.

The transitions, which results after the decoding of a CREATIVE MESSAGE can be, resume in the following **STOCHASTIC MATRIX**:

	E	C
E	e_{11}	e_{12}
C	e_{21}	e_{22}
A	e_{31}	e_{32}

The three levels of decoding aren't independents, the **E transitions** conditioned the results of **C events**, also these conditioned the results of **A events**.

Using this reasoning for the calculus of H(C| E) entropy, we obtain:

$$\sum_{w=1}^{3} \sum_{q=1}^{3} \sum_{k=1}^{3} p_{wqk}))) = 1 \qquad (2)$$

what means, we are near a complete system of events.

The three results of A events are realized each by 9 probability.

For each realization of a $\mathbf{e}_{2q}$ result from C event are correspond a repartition with form:

e_{31}	E_{32}	e_{33}
$p_{31\mid 2q\mid 1w}$	$P_{32\mid 2q\mid 1w}$	$p_{33\mid 2q\mid 1w}$

where w have three values 1<= **w** >= 3 for each 1<= **q** >= 3

For these 9 repartition are correspond 9 entropies with the next type:

We have again aleator variables with the next repartitions:

$H(A!e_{2q}!e_{1w}$ where for each **q** $1<=$ **q** $<= 3$

$p_{1w}.\ p_{2q|\ 1w}$ and for each **w** $1<=$ **w** $<= 3$

the weight medium of this repartition is::

$$H(A/C/E) = \sum_{w=1}^{3}\sum_{q=1}^{3} p_{1w}.p_{2q/1w}\, H(A/e_{2q/}/e_{1w}\ )) \tag{3}$$

Replaced in the last relation the $H(A!e_{2q!1w})$ entropy , we obtain the entropies of **C** and **E** events:

$$H(A/C/E) = -\sum_{w=1}^{3} p_{1w}.\sum_{q=1}^{3} p_{2q/1w}.\sum_{k=1}^{3} p_{3k/2q/1w}.\log p_{3k/2q/1w}))) \tag{4}$$

3. THE INFORMATIVE, FORMATIVE, CREATIVE AND CONCOMITENT DIDACTICAL INTERACTIONS ENTROPY

We will calculate the concomitant events H(A,C,E) entropy, of EXPLICATIVE, KNOWLEDGE AND CREATIVITY ELEMENTS:

$$H(A,C,E) = -\sum_{w=1}^{3}\sum_{q=1}^{3}\sum_{k=1}^{3} p_{wqk}.\log p_{wqk}))) \tag{5}$$

but: $p_{wqk} = p_{1w}.p_{2q|\ 1w}.p_{3k|2q|\ 1w}$

from the last two equations have result:

$$H(A,C,E,) = -\sum_{w=1}^{3}\sum_{q=1}^{3}\sum_{k=1}^{3} p_{1w}.p_{2q/1w}\ \ p_{3k/2q/1w}.\log(p_{1w}.p_{2q/1w}.p_{3k/2q/1w})))) \tag{6}$$

or:

$$H(A,C,E) = -\sum_{w=1}^{3} p_{1w}.\sum_{q=1}^{3} p_{2q/1w}.\sum_{k=1}^{3} p_{3k/2q/1w}.(\log p_{1w} + \log p_{2q/1w} + \log p_{3k/2q/1w})))$$

or:

$$\begin{aligned} H(A,C,E) = &-\sum_{w=1}^{3} p_{1w}.\log p_{1w}.\sum_{q=1}^{3} p_{2q/1w}.\sum_{k=1}^{3} p_{3k/2q/1w}))) + \\ &-\sum_{w=1}^{3} p_{1w}.\sum_{q=1}^{3} p_{2q/1w}.\log p_{2q/1w}.\sum_{k=1}^{3} p_{3k/2q/1w}))) + \\ &-\sum_{w=1}^{3} p_{1w}.\sum_{q=1}^{3} p_{2q/1w}.\sum_{k=1}^{3} p_{3k/2q/1w}.\log p_{3k/2q/1w}))) \end{aligned} \tag{7}$$

In the last relation the product:

$$\sum_{q=1}^{3} p_{2q/1w}.\sum_{k=1}^{3} p_{3k/2q/1w} = 1 \tag{8}$$

for each value of w, because for every value of w are correspond three values for q, and for each values for q are corresponding three values for k :

For example, for w=1 and q=1 we have the next equality:

$$\sum_{k=1}^{3} p_{3k/21/11} = 1 \tag{9}$$

because its the sum of all probabilities of realization of results of $\mathbf{e}_{3k/21/11}$ events, conditioned by the realization of $e_{21/11}$ results. The sums which are result have the next form:

$$\sum_{q=1}^{3} p_{2q/1w} \tag{10}$$

are equal with 1 too, because they are respectively the sums of $\mathbf{e}_{2q}$ conditioned results probabilities. In this case the first element became:

$$-\sum_{w=1}^{3} p_{1w}.\log p_{1w} \tag{11}$$

what is not other then H(E) .

In the second element, the sums with form::

$$\sum_{k=}^{3} p_{3k/2q/1w} \tag{12}$$

are each equals with 1, because they are respectively the sums of probabilities of $\mathbf{e}_{3k}$ conditioned results.

Therefore, the second term become:

$$-\sum_{w=1}^{3} p_{1w} \cdot \sum_{q=1}^{3} p_{2q/1w}.\log p_{2q/1w})) \tag{13}$$

that is H(C|E), the entropy of KNOWLEDGE decoding, conditioned by the EXPLICATIVE ELEMENTS decoding.

The third term have the form which we obtain for conditioned entropy of creativity H(A|C|E) .

Finally, results the ENTROPY OF STOCHASTIC MODEL **G**:

$$\boxed{H(A,C,E) = H(E) + H(C|E) + H(A|C|E)}$$

PRACTICALLY, the measurement of these entropy needs the contouring of $\mathbf{e}_{3k|2q|1w}$ transitions with 27 contours with the follow form $\mathbf{n}_{3k|2q|1w}$, where for every **k** are correspond three values for **q**, and for every q are correspond three values for **w**.

CONCLUSIONS

In the frame of these scientific events, this is the last from a lot of three papers, which preoccupations where to create the concordance between the DIDACTIC realizations

and other fields of knowledge. Also, the introducing of measurement in **didactic interactions**, with the transformation of **quality** in **quantity**, and the introducing of STOCHASTIC MODEL **G**, as a new method of didactic presentation.

Annex:
TABEL of STOCHASTIC MODEL **G** contours

G ↓ →		E	C	A	
E	w→	1	2	3	
		n_{11}	n_{12}	n_{13}	
C	q→	1	2	3	w ↓
		$n_{21\|11}$	$n_{22\|11}$	$n_{23\|11}$	1
		$n_{21\|12}$	$n_{22\|12}$	$n_{23\|12}$	2
		n_{2113}	$n_{22\|13}$	$n_{23\|13}$	3
A	k→ / w ↓	1	2	3	q ↓
	1	$n_{31\|21\|11}$	$n_{32\|21\|11}$	$n_{33\|21\|11}$	1
		$n_{31\|22\|11}$	$n_{32\|22\|11}$	$n_{33\|22\|11}$	2
		$n_{31\|23\|11}$	$n_{32\|23\|11}$	$n_{33\|23\|11}$	3
	2	$n_{31\|21\|12}$	$n_{32\|21\|12}$	$n_{33\|21\|12}$	1
		$n_{31\|22\|12}$	$n_{32\|22\|12}$	$n_{33\|22\|12}$	2
		$n_{31\|23\|12}$	$n_{32\|23\|12}$	$n_{33\|23\|12}$	3
	3	$n_{31\|21\|13}$	$n_{32\|21\|13}$	$n_{33\|21\|13}$	1
		$n_{31\|22\|13}$	$n_{32\|22\|13}$	$n_{33\|22\|13}$	2
		$n_{31\|23\|13}$	$n_{32\|23\|13}$	$n_{33\|23\|13}$	3

BIBLIOGRAPHY:

[1] Ashby, Ross, W. Introducere în cibernetică. Editura tehnică, Bucureşti, 1972.
[2] Bruner, S., Jerome, Pentru o teorie a instruirii, Editura Didactică şi Pedagogică, Bucureşti, 1970.
[3] Bush, R., Mosteller, F. Modelul stochastic al învățării. În: FIZMATGIZ, Moskova, 1962, p.77.
[4] Estes, W.K. Tosard a statistical theory of laring. În: Psyhological Review. 57, 1950,pp94-107.
[5] Guiaşu, S.,
/1. Matematica şi informația, Editura tehnică, 1965.
/2. Aplicații ale teoriei informației, Editura Academiei R.S.R., Bucureşti, 1968.
[6] Komensky, J., A., Texte alese, Didactica Magna, Editura De Stat şi Pedagogică, Bucureşti 1958.

[7] Kolmogorov, A., N,.
/1.Grundbegriffe der Warscheinlichkeitserechnung, Mathematische Ergebnisse Nr. 3 Berlin, 1933,
/2. Cibernetică. Marea Enciclopedie Sovietică, 51, 1958, pp. 149-151.
/3. Teoria transmisiei informației. Analele româno-sovietice, seria Mat-Fiz., 1, 1959, pp 5-33.
[8] Markov, A., A.,
/1. Rasprostranenie zakona bolsih cisel na velicini zaviseascie deug ot druga. Izd. Fiz. Mat. Obsc. Pri. Kazansk. Univ., 2 seria, 15, nr. 4, 1906, pp. 135-156.
/ 2. Iscislenie voraiatnostei, Izd. 4, Moskva, Gosizdat, 1924.
/ 3. Procese Markov şi lanțuri Markov în Mica Enciclopedie Matematică. Editura tehnică, Bucureşti 1980, p. 742.
[9] Novac, Eugen:
/1. Asupra comunicării "Programa studiului fizicii ca factor de însuşire conştientă acunoştințelpr de către elevi" , Comunicare la Societatea de Matematică Fizică, noiembrie 1960, Baia Mare.

/2. Didactica fizicii, Studiu de pedagogie experimentală, asupra programării didactice **G** şi a operatorilor **G**, 1960-1967, Xerox, 48 pagini, 6 tabele, 7 diagrame, 11 figuri.

/3. Mijloace tehnice de transmitere a informației în procesul de învățământ. Revista de Pedagogie, nr. 4., Bucureşti 1968.

/4. Insatalații didactice, Editura Didactică şi Pedagogică , Bucureşti 1973.

/5. Contribuții la dezvoltatrea mijloacelor tehnice de învăşământ - Computerul didactic. Teza de doctorat. 225 pagini, 99 figuri, planşe, tabele, grafice, fotografii. Universitatea Timişoara, 24 octombrie 1974.

/6. Computerul didactic. Studiu de pedagogie modernă., 1970-1974, Xerox, 109 pagini.

/7. Studiul comportamentului sistemului de instruire, În: Studentul de azi profesorul de mâine, pp. 123-127, Editura Didactică şi Pedagogică, Bucureşti 1976.

/8. Insatalații didactice electronice de predare metodică, În: Studentul de azi profesorul de mâine, pp, 298-302, Editura Didactică şi Pedagogică, Bucureşti 1976.

/9. Sisteme dinamice ale tehnologiei didactice, În vol.,6 pp. 173-178, Biblioteca Societății de Ştiinşe Matematice din R.S.R.,Bucureşti 1979.

/10. Opertori **G** în măsurarea interacțiunii didactice, În: Buletinul de Fizică şi Chimie , vol .XI, nr. 11., pp. 304-313, Bucureşti 1987.

/11. Modelul stochastic **G** în testarea roboților autoinstruibili., În: vol, II", pp. 18-24, Simpozionul național de roboți industriali, 26-28 octombrie 1989", I;S.,Baia Mare.

/12. Modelul stochastic **G** în teoria informaşională a instruirii, pentru conducerea procesului de instruire. Comunicare la sesiunea jubiliară "A 75-a aniversare a Universității Babeş- Bolyai Cluj-Napoca ", Cluj- Napoca 1994.

/13. Modelul stochastic **G** în evaluarea şi optimizarea procesului de instruire din clubul didactic. Comunicare la Simpozionul UNICEF, 10 decembrie 1994. Baia Mare, În: Colecția UNICEF.

/14. Stochastic Model **G** in Information theory of Instruction for calculus the entropy of didactic informative interaction.În SCIENTIFIC BULETIN Serie C, Volume XIII, pp. 167-172, NORTH UNIVERSITY OF BAIA MARE, 1999.

/15. Stochastic Model **G** in Information theory of Instruction for calculus the entropy of didactic formative interaction. În SCIENTIFIC BULETIN Serie C, Volume XV, pp. 189-196, NORTH UNIVERSITY OF BAIA NARE, 2001.

[10] Onicescu, O., Calculul probabilităților. Editura Tehnică, Bucureşti, 1956.

[11] Okon, Vicenty, Didactica generală. Editura Didactică şi Pedagpgică, Bucureşti 1974.

[12] Salade, D., Didactica, Editura Didactică şi Pedagogică, Bucureşti 1982.

[13] Shannon,C.,E.,A Matematical Theory of Comunication Bell Technical Journal 27,1948,pp.379-423, 623-656.

[14] Von Neumann, J., The general and Logical Theiry of Automata Massachussets, Institute of technology, 1948.

[15] Wiener, N., Cibernetica, Hermann, Paris 1948.

[16] Suppes, P., Atkinson, R., C., Markov Learing Models for Muktiperson Interactions Stanford (COLIF), 1960.