

Development of Teacher Students' Thinking Skills and Its Relation to Acquisition of Pedagogical Content Knowledge for Science Teaching in High School

Mario Quintanilla Gatica

Laboratorio de Investigación en Enseñanza de las Ciencias e Investigación Aplicada
(GRECIA) Facultad de Educación
Universidad Católica de Chile

mquintag@uc.cl

www.laboratoriogrecia.cl

Scientific Thinking Skills, teacher professional development and learning.

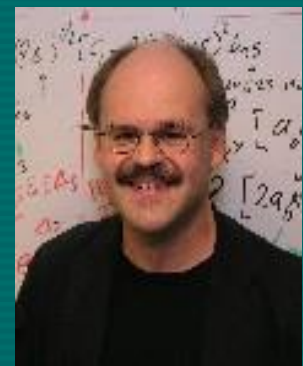
AKA - CONICYT 04 (2011 -2014)



Dr. Mario Quintanilla



Dr. Ismo Koponen



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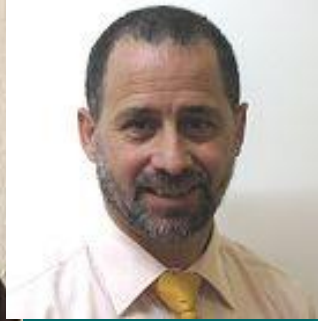
CHILEAN RESEARCHERS AND TEAM INVOLVED. Universidad Católica de Chile (Principal). U.Santo Tomás, U. Central de Chile, U. de Santiago de Chile. U. de Concepción. U. Iberoamericana de Ciencia y Tecnología (secondary)

NAME / Disciplinary area		ROLE IN THE PROJECT
MARIO QUINTANILLA G.	PH.D SCIENCE EDUCATION (Chemistry and Biology)	PROJECT COORDINATOR, PRINCIPAL INVESTIGATOR
ALBERTO LABARRERE LUIGI CUELLAR F. CARLA HERNANDEZ S. VERONICA ASTROZA RICARDO DE LA FUENTE	PH.D PSYCHOLOGIST PH.D SCIENCE EDUCATION (Chemistry) PH.D SCIENCE EDUCATION (Physics) MSC. CURRICULUM EDUCATION (Biology) MSC CURRICULUM EDUCATION (Biology)	- INVESTIGATORS (5)
CAROL JOGLAR , OLGA MALVAEZ , JUAN BRUNSTEIN, YANINA TAPIA		PH.D STUDENTS (4)
KATHERINE MEDINA, CHRISTIANSEN GODOY, PATRICIO FARFAN, YADRAN GOMEZ, TAMARA SAAVEDRA, SEBASTIAN URRRA		DEGREE STUDENTS (6)
SYLVIA ARAYA ., CLAUDIO LIBUY H, FRANKLIN MANRIQUE EUGENIA PINO, RICARDO ROJAS		TECHNICAL SUPPORT (3)
		PUBLICATIONS EDITOR (2)

FINNISH RESEARCHERS INVOLVED DEPARTMENT OF PHYSICS, TEACHER EDUCATION UNIT. UNIVERSITY OF HELSINKI (PRINCIPAL)

DR. ISMO KOPONEN MSC. SHARAREH MAJIDI DR. ARI HÄMÄLÄINEN PHILLIC ILKKA HENDOLIN	PH.D PHYSICAL SCIENCE PH.D PHYSICAL SCIENCE	PROJECT COORDINATOR, INVESTIGATOR PHD STUDENT, INVESTIGATOR INVESTIGATOR, TECHNICAL SUPPORT INVESTIGATOR, TECHNICAL SUPPORT
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CHILEAN TEAM



Research Laboratory in Science Education

- A multidisciplinary UC team from 1998.
- Collective and diverse cultural and professional knowledge (biology, chemistry, physics, medicine, philosophy, psychology, education).
- 16 Chilean and Latino-American scholarships (Spain, Colombia, Argentina, Brasil, Chile).
- Leader of 20 projects of national and international collaboration since 1998 (Spain, Finland, Canada, Mexico, Brazil, Colombia, Argentina and other Latin American countries).



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Cultural context. Our initial discussion

- Complex world in constant transformation . What science and science education is promoted in citizenship?
- Are we aware of these complexities or do we have a 19th century notion of science?
- We believe in a science that interprets the world in which we live, with scientific theories (that change with the knowledge and tools available) or do we repeat memoristically the scientific content of the curriculum away from the reality of the school and each student?
- We believe in training science teachers as a process of continuous critical reflection. Does this develop in a lab that is the own teachers classroom (emotions, values, languages, cultures and attitudes) or outside classrooms, in successive training?



- Emotions,
- Different languages
- Culture, values.
- Political, bioethics and religious controversies

Our initial discussion

- ❑ How does science promote peace and democracy?
- ❑ How would a quality scientific education be?
- ❑ How do we teach science for diversity and in disadvantaged contexts?



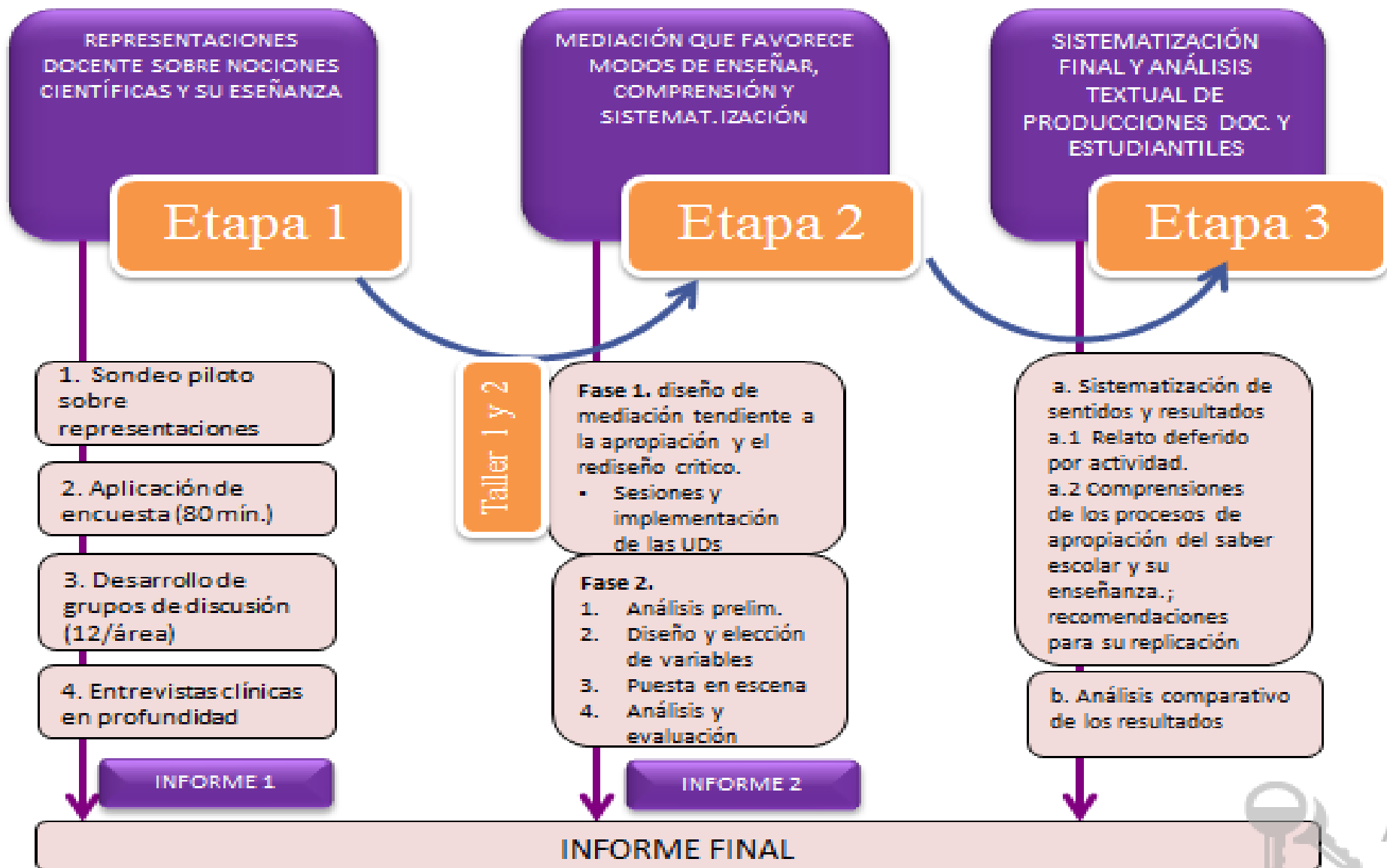
Meaning and purpose of international collaboration

1. Understanding the processes of teaching, learning and scientific evaluation in different cultural contexts.
2. Exchanging methodological and theoretical models about the training of teachers of science in Chile and Finland.
3. Identify and characterize epistemological difficulties in learning specific scientific notions of chemistry, biology and physics in secondary education in Chile and Finland.
4. Promote stays short and extensive research to PhD students and researchers in Chile and Finland.
5. Develop visits to schools in both countries and observe the teaching of science in different educational levels.
6. Produce educational materials based on theoretical models analyzed during the investigation.
7. Promote networks of international collaboration between research groups developing similar theoretical and methodological models in Latin America.

General profile of science teachers involved in the project AKA04

- The project starts with 132 science teachers (high school).
- 20 years of service (average).
- Ages 28 and 60. 65% are female and 35% male.
- Different institutional sources (public and private education)
- Voluntarily participate in the project AKA04.
- Recognize dissent and inconsistencies between the contents of the official curriculum of Chile, to teach science and science who want their students to learn.
- Science teachers value their participation in the project AKA04 and participate in various stages between 2011 to 2014

Methodology and instruments



Participation in workshops to exchange experiences in science education (36 workshops, 3 years)

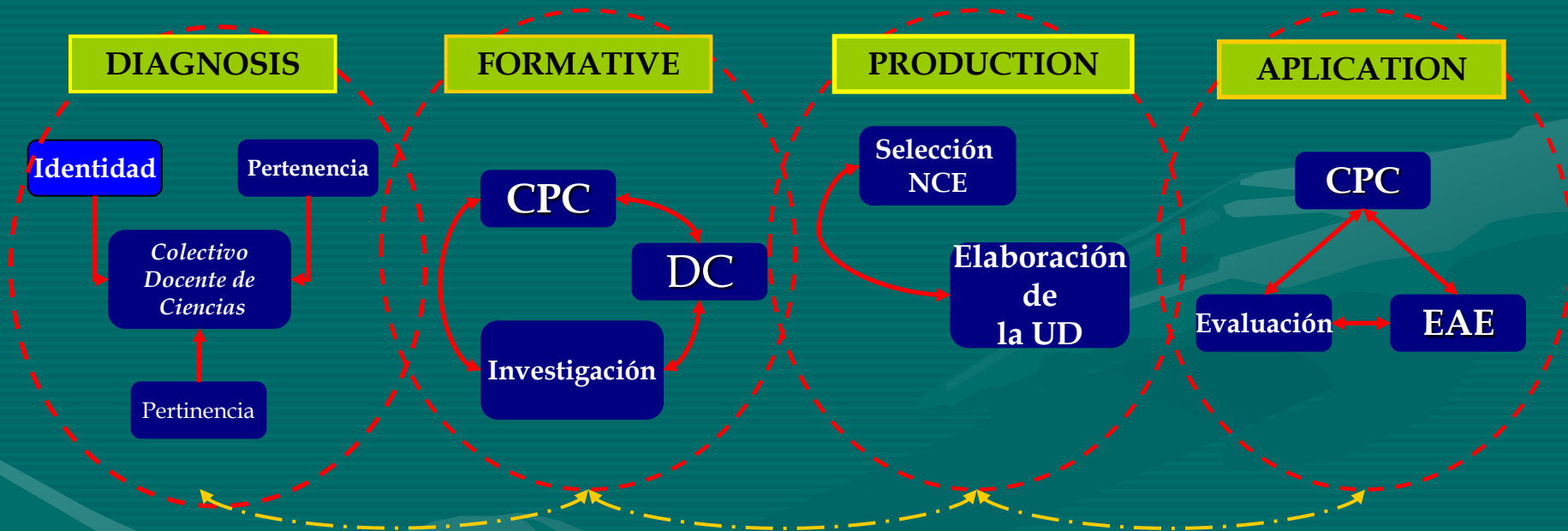


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Theory and Practice of generating data in each group of science teachers (biology, chemistry and biology)





Understand our idea of science and science education. Develop scientific thinking and a 'new idea of learning' of science

(Brunstein ,2014, Joglar,2014,Cuellar,2010, Quintanilla et als,2011)

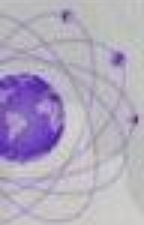
**Systematic theoretical training for 3 years.
Different contexts about science education**

**Theoretical, epistemological and methodological reflection from their
practical classroom teaching science**



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Observation and recording of classes in chemistry, biology and physics
Discussion on methodologies and resources in different activities
(experimental, theoretical, individual, group). Stop a moment and look 'my
class and how to teach science' What contradictions identified?



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Which competences for science education ?

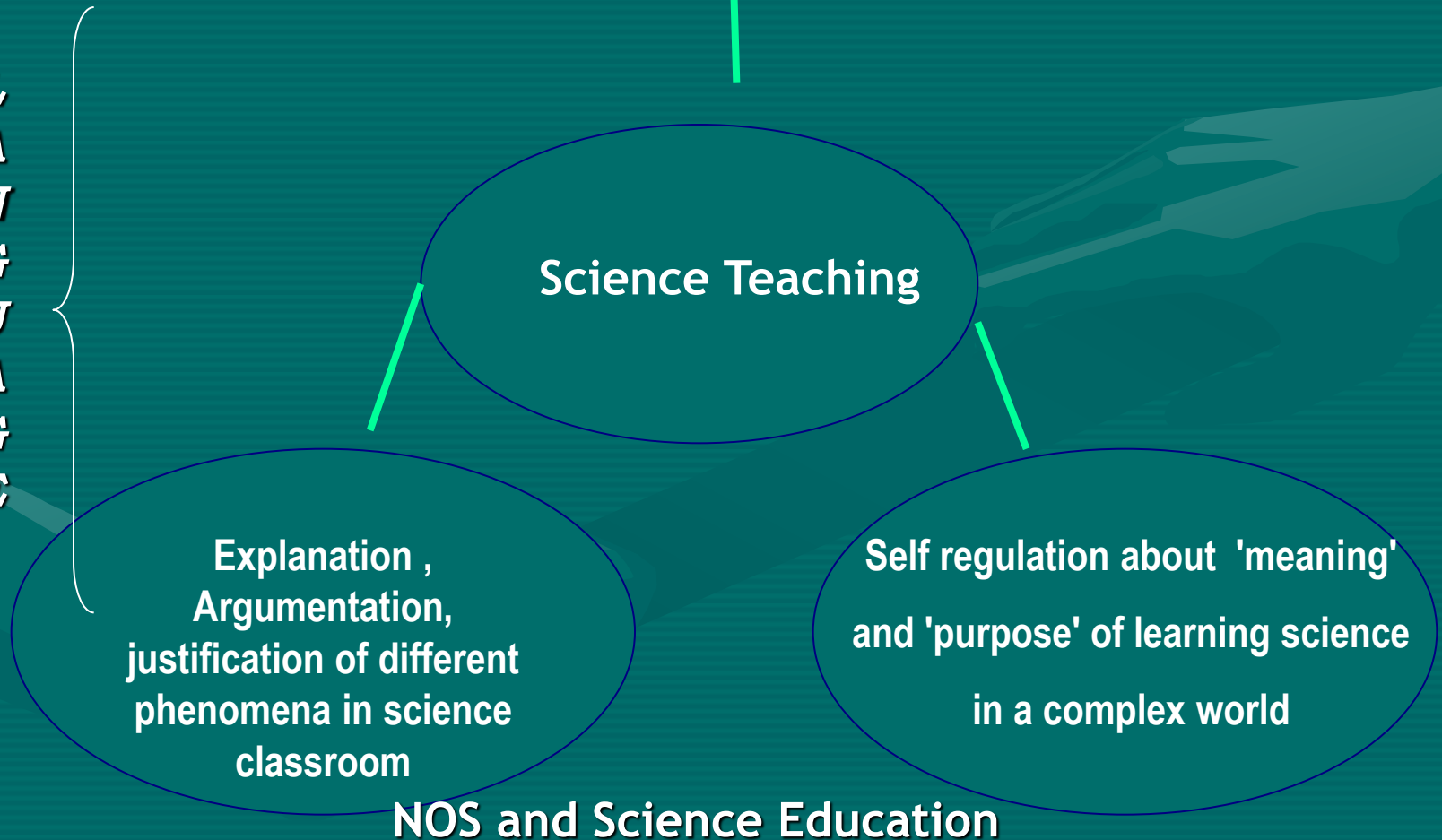
- Argumentation
- Explanation
- Justification
- Problem solving
- Formulate questions



More coherence between the theoretical model of science and its teaching: The importance of language in school

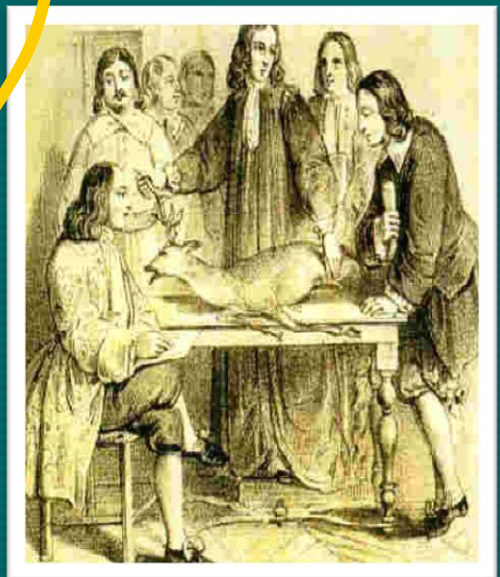
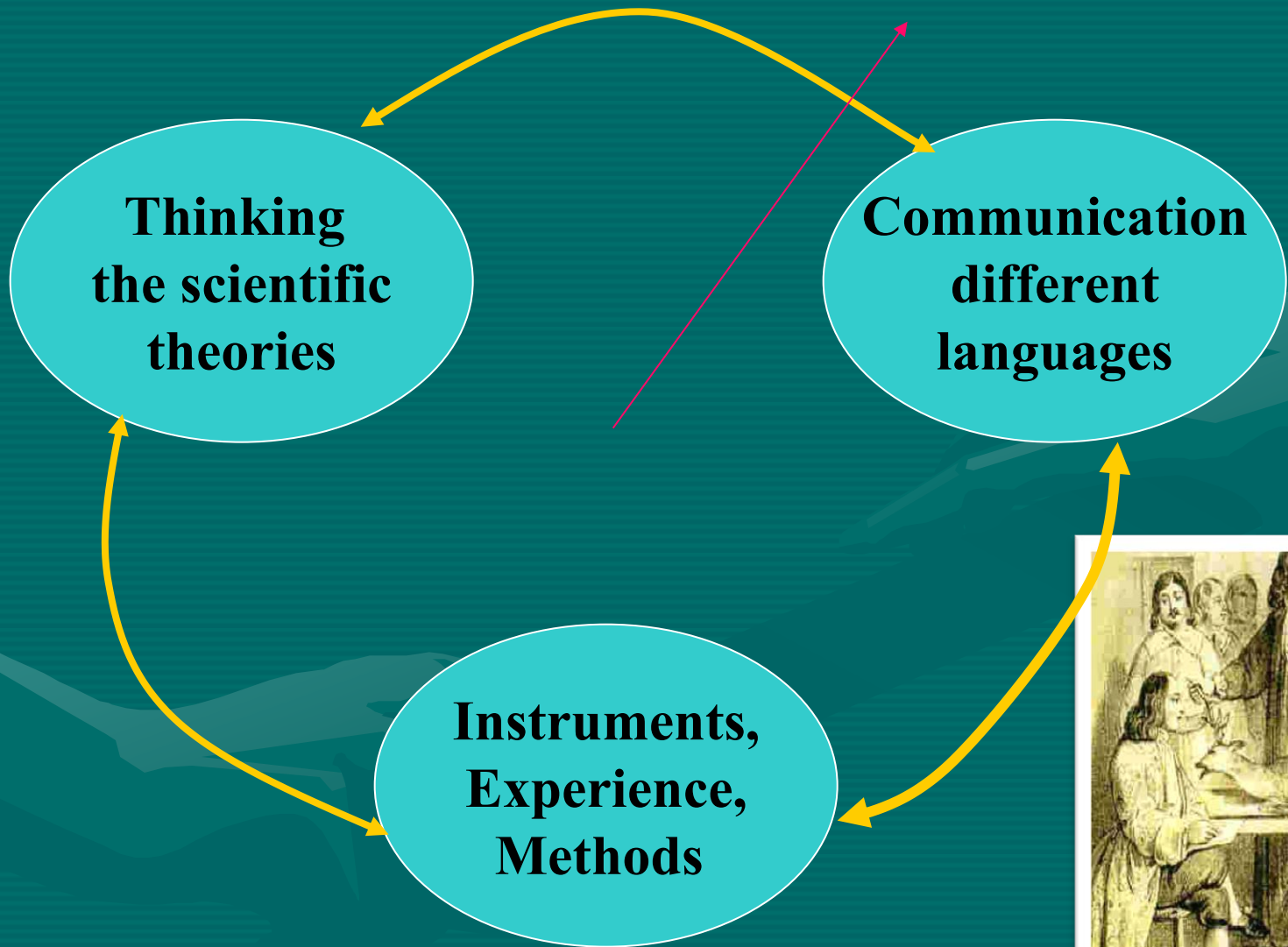
Emotions, different languages, culture, values, political, bioethics and religious controversies

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**New challenges for a
'new science education'**

scientific thinking skills



Relevant results and added value of collaborative research

- Identification and characterization of theoretical models of science and science education of science practicing teachers.
- Theoretical and practical contributions for teachers in scientific thinking skills in biology, chemistry and physics (argumentation, explanation, justification, problem solving, questioning, etc.).
- The project developed relevant activities with high school and Ph.D students, professors and researchers. They benefited for example in visiting professors, research stays, courses, workshops, seminars, conferences, videoconferences, publications.

Relevant results and added value of collaborative research

- During the project implementation other researchers started collaborating; coming from Canada, Spain, Argentina, Mexico, Colombia, Brazil and Uruguay. This situation was not originally considered, but it promoted the AKA04 project in other universities and research groups of science education in Latin America.
- During the AKA04 project implementation the *Chilean Society of Teaching, History and Philosophy of Science* was created. This entity organized in Santiago of Chile, the Third Latin American Congress of History, Philosophy and Science Teaching (2014). Attended by 350 researchers, teachers and Ph.D students from 8 countries, including Canada, Germany and Spain.

Productivity indicators	Year 1	Year 2	Year 3	Total
Books (print and / or digital)	2	2	3	7
Scientific articles, ISI, Scielo or SCOPUS.	3	3	3	9
Development and implementation of web sites to assist in the training of science teachers www.laboratoriogrecia.cl www.sociedadbellaterra.cl	1	1	0	2
Undergraduate thesis (Finnish advisory team).	2	2	1	5
Master Thesis.	1	1	0	2
PH.D Theses (Finnish consulting team).	4	0	0	4
Papers presented at Latin American and European international congresses	10	10	10	30
Research stay (3 months or more)	3	0	0	3
Research stay (15 days to 1 month)	1	2	1	4
Conferences and Seminars dissemination of the project	4	6	6	16
Total	31	27	24	82

Contributions to science education

- **Development of a theoretical and methodological professional development model for science teachers.**
- **Development of a research model of scientific thinking skills and teacher training.**
- **Contributions for the initial public policy debate in science education.**
- **Innovative strategies for evaluating scientific learning (e.g. Use of the history of science in the classroom to promote scientific thinking skills).**
- **Publications produced with science teachers (on line).**

Future projections

- **Validate, in other levels of science education research, the model developed in AKA04.**
- **Add new valuable and relevant research issues in international collaboration such as scientific education, citizenship and values; gender and science; public policies in science education.**
- **Promote the exchange of new doctoral students interested in science education and training of science teachers.**
- **Publication of a new book with the results of the investigation. We hope to have it printed in the next seminar!**



International Network of Researchers in Science Education

8 countries, 34 universities and research associates, 28 senior researchers and 45 Ph.D students.

Thanks ...

Mario Quintanilla Gatica

mquintag@uc.cl

mriorqg@gmail.com

www.laboratoriogrecia.cl

Facultad de Educación
Universidad Católica de Chile