

# Inter-University Project on Collaborative Physics Workshops: an Ibero- American Experience

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# Inter-University Project on Collaborative Physics Workshops: an Ibero-American experience

- ▶ Introduction
- ▶ Objectives
- ▶ Inquiry-based science workshops (theoretical framework)
- ▶ Teacher training proposal & Research methodology
- ▶ Results
- ▶ Concluding remarks



# Introduction



## TEACHER TRAINING PROGRAMS...

They should be based on the promotion of **professional competencies**.

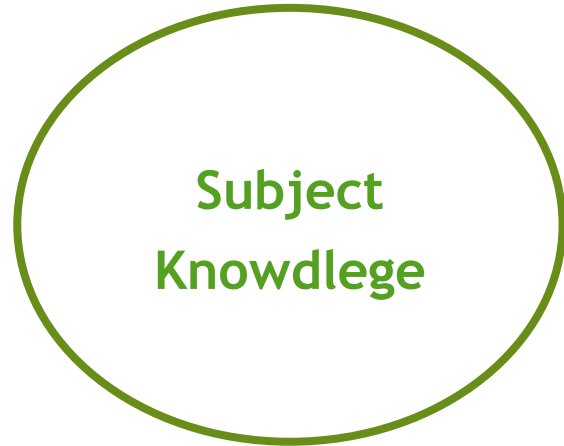
They should encourage a shift from traditional to **alternative teaching approaches**.

They should promote **reflection and metacognition** about educational strategies.

(Perrenoud, 2001; Van Driel & Berry, 2012; Gess-Newsome, 2015)

# Introduction (II)

## TEACHER TRAINING PROGRAMS...

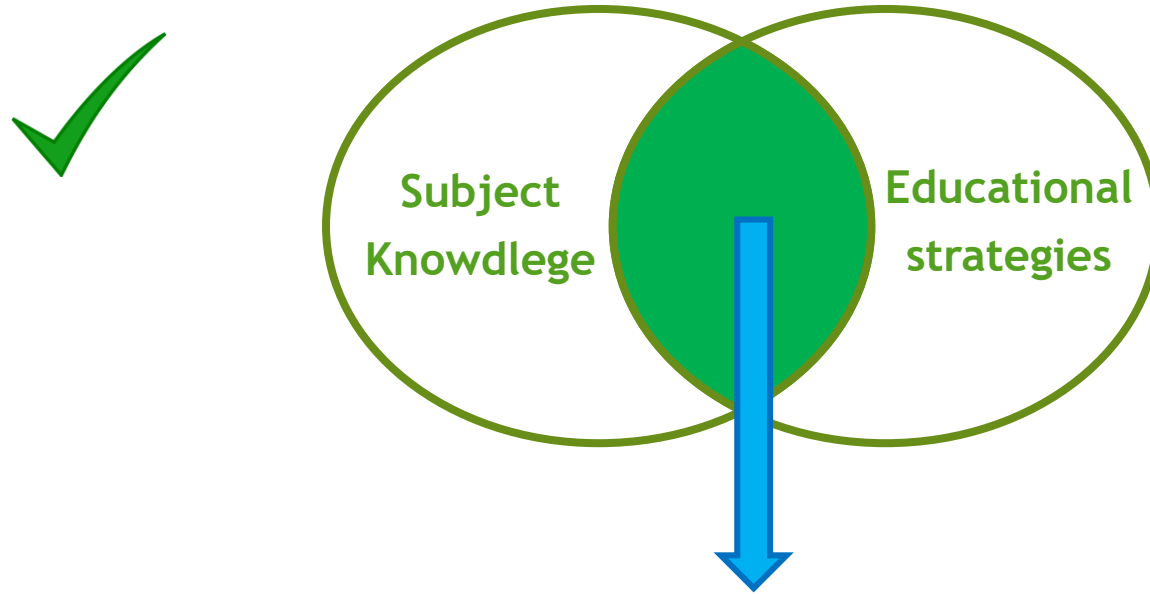


The methodologies that future teachers are trying to acquire are not valid for their own learning about physics, chemistry, maths...?



# Introduction (III)

## TEACHER TRAINING PROGRAMS...



An approach coherent with the idea of **Pedagogical Content Knowledge (PCK)**

Teachers should interact with subject knowledge **following similar strategies** to those that are intended to acquire (e.g., problem-based learning, project-based learning, workshops...)

(Martínez-Aznar, Rodríguez-Arteche, & Gómez-Lesarri, 2017)

# Introduction (IV)

## SCIENCE TEACHER TRAINING PROGRAMS...



Teachers should **personally experience** what learning through innovative methods (e.g., inquiry-based science education) implies: benefits, challenges, emotions... (Rodríguez-Arteche & Martínez-Aznar, 2016)

JOURNAL OF  
**CHEMICAL EDUCATION**

Article

pubs.acs.org/jchemeduc

Introducing Inquiry-Based Methodologies during Initial Secondary Education Teacher Training Using an Open-Ended Problem about Chemical Change

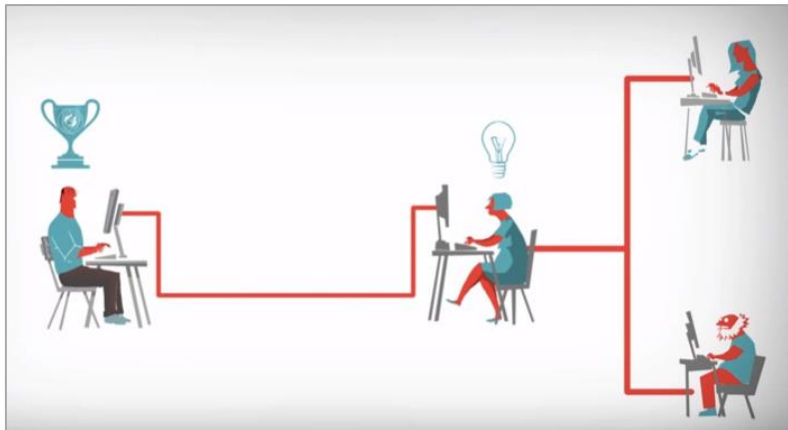
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# Introduction (V)

## TEACHER TRAINING PROGRAMS IN A TECHNOLOGICAL WORLD...



### European Framework for the **Digital Competence of Educators**

DigCompEdu

Christine Redecker (Author)  
Yves Punie (Editor)



**Professional networks** as opportunities for personal and community growth.

**Digital competence** as a key area for professional development.

Necessity of aligning **training proposals** with this technological context.

# Inter-University Project on Collaborative Physics Workshops: an Ibero-American experience

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- ▶ **Objectives**
- ▶ Inquiry-based science workshops (theoretical framework)
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# Objectives

## INTER-UNIVERSITY PROJECT ON COLLABORATIVE PHYSICS WORKSHOPS

### Learning Objectives

- ♣ Promote the design and analysis of school workshops on “light and colour” and “electrical circuits”, based on inquiry-based tasks.
- ♣ Encourage the participants to model the nature of inquiry-based workshops.

### Research Objective

1. Analyse the contribution of the training proposal to the future teachers’ **professional skills**.
2. Evaluate the relevance of **technical and personal contributions** during the development of the project.
3. Analyse the **evolution in** future teachers’ **beliefs** regarding the nature of science workshops.

# Inter-University Project on Collaborative Physics Workshops: an Ibero-American experience

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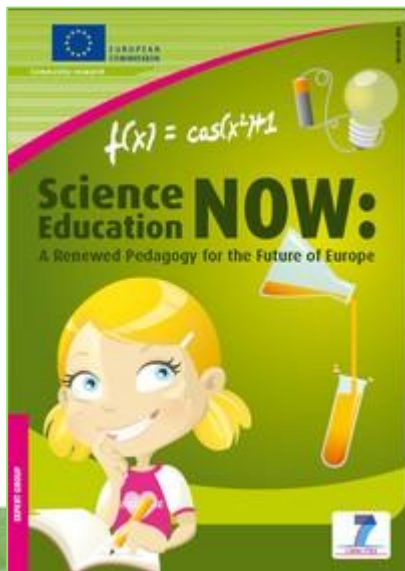
# Theoretical framework

## Inquiry-Based Science Education (IBSE)

A recommended approach for promoting conceptual and procedural knowledge, and positive attitudes towards science.

«The intentional process of diagnosing problems, critiquing experiments and distinguishing alternatives, **planning investigations**, researching conjectures, searching for information, **constructing models\***, debating with peers, and **forming coherent arguments\*** (Linn, Davis, & Bell, 2004)».

*Scientific practices*



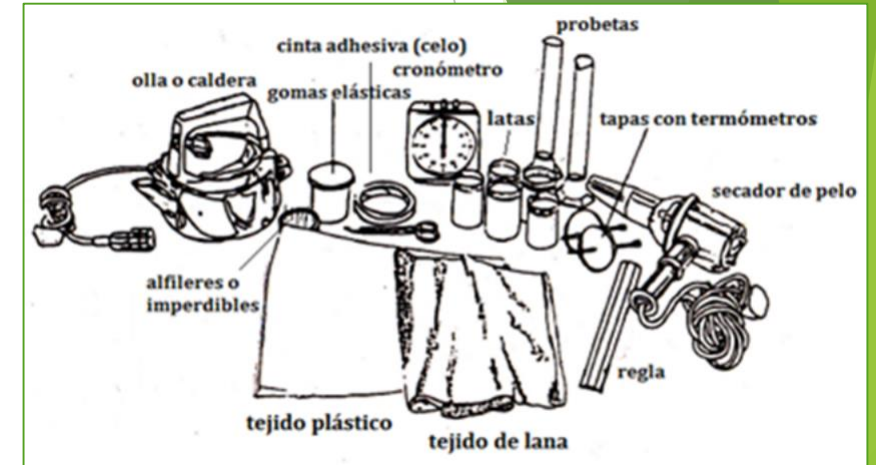
# Theoretical framework

## Inquiry-Based Science Education (IBSE)



How many balloons are needed to keep standing three teachers?

Inquiry focused on **procedural** learning



If you had to keep something cold for as long as possible, what would you do? Wrap it in wool or put it in a metal container?

Inquiry focused on **conceptual** and **procedural** learning

*In any case, scaffolding = teacher's role of guiding is fundamental in IBSE*

(Hmelo-Silver, Duncan, & Chinn, 2007)



# Theoretical framework

## Inquiry-Based Science Education (IBSE)



(Herron, 1971; Wheeler, Bell, Whitworth, & Maeng, 2015)

Inquiry type	Solution provided?	Procedure provided?	Research question provided?
Confirmation inquiry (L1)	YES	YES	YES
Structured inquiry (L2)	NO	YES	YES
Guided inquiry (L3)	NO	NO	YES
Open inquiry (L4)	NO	NO	NO

**SCIENCE WORKSHOPS** as structured inquiry: the topic and a sequence of questions are given to guide and orient knowledge construction.

Connected to **Conceptual Change** theory (Posner, Strike, Hewson, & Gertzog, 1982).

# Theoretical framework

## Inquiry-Based Science Workshops

### Requirements:

- ▶ Sequence the activities
- ▶ Contextualise the tasks
- ▶ Choose appropriate materials
- ▶ Plan an adequate scaffolding
- ▶ Promote cooperative group
- ▶ Favour autonomy and self-reflection of students

(Silva & Fillat, 1997)



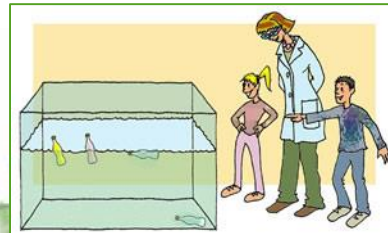
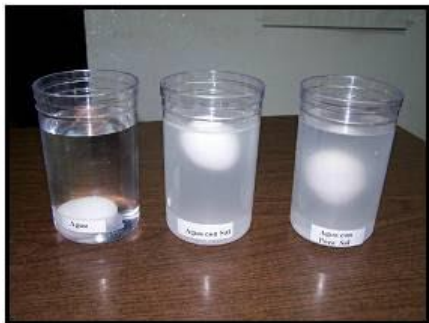
# Theoretical framework

## Inquiry-Based Science Workshops

Example: *A workshop about buoyancy*

Modeling

- ▶ *Why do ships float?* → Working with plasticine in different forms **BODY**
- ▶ *What happens to this egg?* → Working with salt solutions with different concentrations **FLUID**
- ▶ *Does it float or sink?* → Working with filled bottles and different solutions **BOTH**



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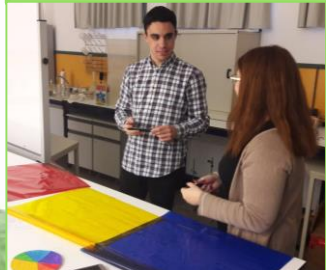


# Teacher training proposal (I)

## PARTICIPANTS

### SPAIN

- 8 future teachers -2 work groups-  
(6 female and 2 male; average age: 20.75)
- PRIMARY Education Degree.  
Universidad Complutense de Madrid
- «Physics & Chemistry Workshop»  
(elective subject, 60 hours)



### PERU

- 21 future teachers -4 work groups-  
(9 female and 12 male; average age: 20.57)
- SECONDARY Education Degree.  
Universidad de Piura
- «Physics II and its didactics»  
(compulsory subject, 60 hours)



# Teacher training proposal (II)

## STAGES (A)

### General idea:

In addition to designing physics workshops, groups of future teachers can compare/assess different workshop approaches for the same topic

➤ Electrical circuits

➤ Light and colour

Initial session of *videoconference* to present the project guidelines



Assignment of the *work groups* in each country and distribution into two topics



Design of *lab activities* in each country, including *videos* to facilitate their resolution



# Teacher training proposal (III)

## STAGES (A)



### DESIGN OF WORKSHOPS

G1 - SPAIN (Electrical circuits) 4 p

G2 - SPAIN (Light and colour) 4 p

G1 - PERU (Electrical circuits) 5 p

G2 - PERU (Electrical circuits) 5 p

G3 - PERU (Light and colour) 6 p

G4 - PERU (Light and colour) 5 p

### ANALYSIS OF WORKSHOPS

G1 - PERU, 5 p

G2 - PERU, 5 p

G3 - PERU, 6 p

G4 - PERU, 5 p

G1.1 - SPAIN, 2 p

G1.2 - SPAIN, 2 p

G2.1 - SPAIN, 2 p

G2.2 - SPAIN, 2 p

# Teacher training proposal (IV)

## STAGES (A)



SPAIN	PERU
Elements of a circuit	Elements of a circuit
Conductors and insulators	Generators
Resistance	Conductors and insulators
Series and parallel circuits	Receivers
Measuring voltage and intensity	Control elements
Joule effect	Series and parallel circuits
Magnet & coil	Measuring voltage and intensity

# Teacher training proposal (V)

## STAGES (B)

Schoology

Forums. Feedback system:

- (+) Strengths
- (-) Weaknesses
- (?) Questions
- (Δ) Suggestions

Taller de Ciencias\_ España - Perú: Section 1  
Universidad Complutense Madrid

Add Materials Options

FORO GENERAL DE COMUNICACIÓN  
Este foro se plantea para que nos presentemos los unos a los otros, conversemos, intercambiamos experiencias... ¡Sintámonos libres de utilizarlo!

Guía para elaborar los Talleres. / Grupos de Trabajo  
Directrices para elaborar los documentos sobre los Talleres de Ciencias.  
10/25/18 12:00am

Entrega de talleres de Circuitos Eléctricos / Luz y Color  
La tarea consiste en cargar los siguientes archivos y enlaces (solo una entrega por grupo)  
- Documento PDF con la propuesta del Taller de Ciencias, según la estructura acordada.  
- Documento ...  
Due Monday, November 5, 2018 at 5:00 pm

Espacio de diálogo (G1\_Perú) sobre el Taller de Circuitos español  
Este foro se utilizará para dialogar sobre el Taller español de Circuitos Eléctricos.  
Por cada Actividad del Taller español se publicará una reflexión grupal con:  
(+) Aspectos positivos detectados...  
Due Sunday, November 11, 2018 at 11:59 pm

Publish the work in the groups on a *collaborative platform* (Schoology)



*Solve and analyze* the workshops of the partners from the other country



*Exchange of reflections* through forums and other documents

# Teacher training proposal (VI)

## STAGES (B)



### Actividad 4: Descubriendo los colores del cielo

(+) La actividad nos ha resultado bastante adecuada. Al trabajar sobre el cielo y el sol puedes motivar bastante a los alumnos debido a que son elementos que se encuentran siempre presentes en su vida.

(+) Preguntas muy apropiadas y bien explicadas.

(-) Respecto a los materiales, con la leche y el agua hasta la visualización del video no sabíamos cuál era la cantidad exacta o aproximada para trabajar. Suponemos que los materiales y la cantidad que se invierta afecten al resultado final.

(?) No nos han surgido dudas con esta actividad.

[Show Less](#)

Like 😊 3 · Reply

[Hide All 3 Replies](#)



**Jean Pierre Gomez Espinoza** Fri Nov 9, 2018 at 11:18 pm

Estimados compañeros, muchas gracias por las críticas, pues nos han ayudado mucho para mejorar nuestro taller para cuando lo desarrollemos con alumnos. Actividad 1: Estamos muy contentos con que no hayan tenido problemas con esta actividad. Actividad 2: Nosotros no hemos intentado el experimento usando una linterna y nos interesa saber los resultados. También compartimos el problema del clima, pues nosotros tuvimos que esperar mucho para que él sol llegue a un lugar donde podíamos grabar. Actividad 3: Lo de la medida del diámetro es una sugerencia pero sí hay que conseguir una adecuada proporción entre el diámetro y la longitud del hilo. Les mostraremos cómo girarlo el día Martes. Actividad 4: En realidad no hay un problema significativo con la cantidad de leche pues basta con unas cuantas gotas, aunque depende también de la cantidad de agua. Cualquier inquietud que aún tengan esperamos poder resolverla el día Martes.

[Show Less](#)

119 interventions in forums (interactions and + / - / ? / Δ)

# Teacher training proposal (VII)

## STAGES (C)

1. Reconocer que los contenidos de circuitos eléctricos / luz y color se pueden secuenciar de formas diferentes. \*

Nada  1  2  3  4  5  Mucho

2. Evaluar de forma autónoma propuestas de talleres diseñados por otros grupos sobre la misma temática. \*

Nada  1  2  3  4  5  Mucho

2. ¿Qué DEBILIDADES destacarías sobre el proyecto de intercambio de talleres entre Perú y España? Justifica tu respuesta.

Texto de respuesta larga

3. ¿Cómo ha evolucionado tu visión sobre los talleres experimentales de física? (¿Qué visión tenías al principio? ¿Ha cambiado a raíz del proyecto) Justifica tus respuestas.

Texto de respuesta larga

4. ¿Cuál es la importancia de los talleres experimentales de física? Justifica tu respuesta.

Texto de respuesta larga

Final session of videoconference.  
Exchange of critical analysis



Project evaluation through *Google Forms* (closed and open questions)



Final communication (Padlet, forums...)

# Teacher training proposal (VIII)

**¡Muy buenas! Yo soy Ifigo y realicé el taller de circuitos eléctricos. Para mí toda esta experiencia ha sido muy gratificante a la vez que innovadora. Nunca lo había hecho antes y me parece una actividad muy interesante. Muchas gracias por compartir con nosotros vuestros experimentos y vuestro tiempo. ¡Un saludo!**

**Buena suerte con lo del pan!!! Se ve que siguen divirtiéndose. Por acá ya estamos en exámenes finales. Mañana les toca a los chicos su examen final de Física II y su didáctica, seguro lo harán muy bien.**

**¡Hola!**  
Gracias a todos por estas experiencias. Personalmente me ha encantado y he aprendido mucho, espero que lo hayan disfrutado tanto como nosotros.  
Saludos desde España.  
Sara

**¡Nos ha encantado!**  
¡Buenas! Soy Amanda y estoy encantada con la experiencia, hemos aprendido mucho, espero que haya sido mutuo.  
Aquí os dejo una foto con Natalia que... bueno, no es nuestra mejor foto pero así os echáis unas risas.  
¡Un placer!

**¡Hola a todos!**  
Después de esta maravillosa y enriquecedora experiencia, seguimos trabajando y esta vez estamos creando un taller de química sobre la fermentación, para ello esta semana hemos intentado (que es lo que cuenta) hacer pan en nuestras casas. Y siempre intentando dar lo mejor de cada uno y con alegría.

**¡Experiencia enriquecedora!!**  
Vaya sí que fue una maravillosa experiencia y sin lugar a dudas muy enriquecedora.  
Al inicio de este taller poco sabía acerca de los circuitos eléctricos y de las utilidades que estas tienen en nuestra sociedad; solo tenía alguna noción acerca de la ley de Ohm y de los ejercicios que se desarrollan en el tema de electricidad. Gracias a esta experiencia he podido conocer muchos aspectos teóricos que me servirán para el diseño de mis clases. Da agradecido por esta maravillosa experiencia.  
Cariño Rodríguez Espinoza

**Un día cualquiera**  
Hola! Soy Natalia, y después de tener una mala noche intentando hacer pan para el taller porque estamos dando la fermentación y que por olfato ha salido comestible que digamos... (un poco duro) ahora estamos en un descanso porque ahora tener clase de lengua! Espero que nos veamos pronto! Ha sido un placer y me ha encantado la experiencia!

**¡Hola!** Como muchos dijisteis en vuestra presentación que os identificabais con el perro como animal. ¡Aquí os presento al mío! Se llama Alan, tiene 4 años y me lo regaló mi hermana cuando cumplí 18 años.

**Hola!!**

**Congreso en Madrid**  
¡Hola! Ayer participamos en un Congreso donde expusimos el trabajo que hacemos en la Universidad Complutense de Madrid sobre la Investigación. Utilizamos la "Metodología de Resolución de Problemas como Investigación".  
<https://bit.ly/3BivUPU>  
<https://bit.ly/3D6S0gh>  
¡Podéis echaros un vistazo a los trabajos anteriores!

**¡Excelente experiencia!**  
Hola! mi nombre es Irma Rocío Osorio Guerrero. Bueno ante todo agradecer tanto a los profesores y estudiantes españoles por permitirnos realizar de la mano esta linda experiencia, que desde mi punto de vista resultó ser muy enriquecedora y gratificante para ambos. Asimismo agradecer a nuestra profesora

**Hola!**

**MARAVILLOSA EXPERIENCIA**

**hola soy David aquí los dejo la comida típica de Huánuco.**

**LA PAHAMANDA.**

**¡Buena experiencia!**  
Hola! soy Paulina.  
Es la primera experiencia que he tenido al trabajar con un grupo de estudiantes de otro país, pues me resultó muy interesante y divertida, además que aprendimos muchas cosas nuevas.

**Una de las mejores experiencias!**  
Para ser sincera, al principio cuando nos propusieron este trabajo no estaba muy contenta porque se veía demasiado tedioso, pero a medida que se iba desarrollando era muy interesante y divertido el hecho de realizar y replicar los diversos experimentos planteados.

The intention is provoking in-depth reflection on the design of physics workshops, while promoting other skills of future teachers: digital competence (video editing, publication of materials, etc.), communication skills...



# Research Methodology

- Online questionnaire with open and closed (Likert scale 1-5) questions.
- Impact of the project to... [Closed questions]
  - **Pedagogical skills** (communication, digital competence, reflection...). 5 questions
  - **Subject-specific skills** (personal understanding, sequence of contents, materials...). 5 questions
- Contribution of some aspects... [Closed questions]
  - **Human contribution** (personal, co-workers, professors...). 4 questions
  - **Technical contribution** (Schoology, video editing, videoconference). 4 questions
- «How has your view on experimental physics workshops evolved as a result of the international project? Justify your answers».

## DESCRIPTIVE ANALYSIS

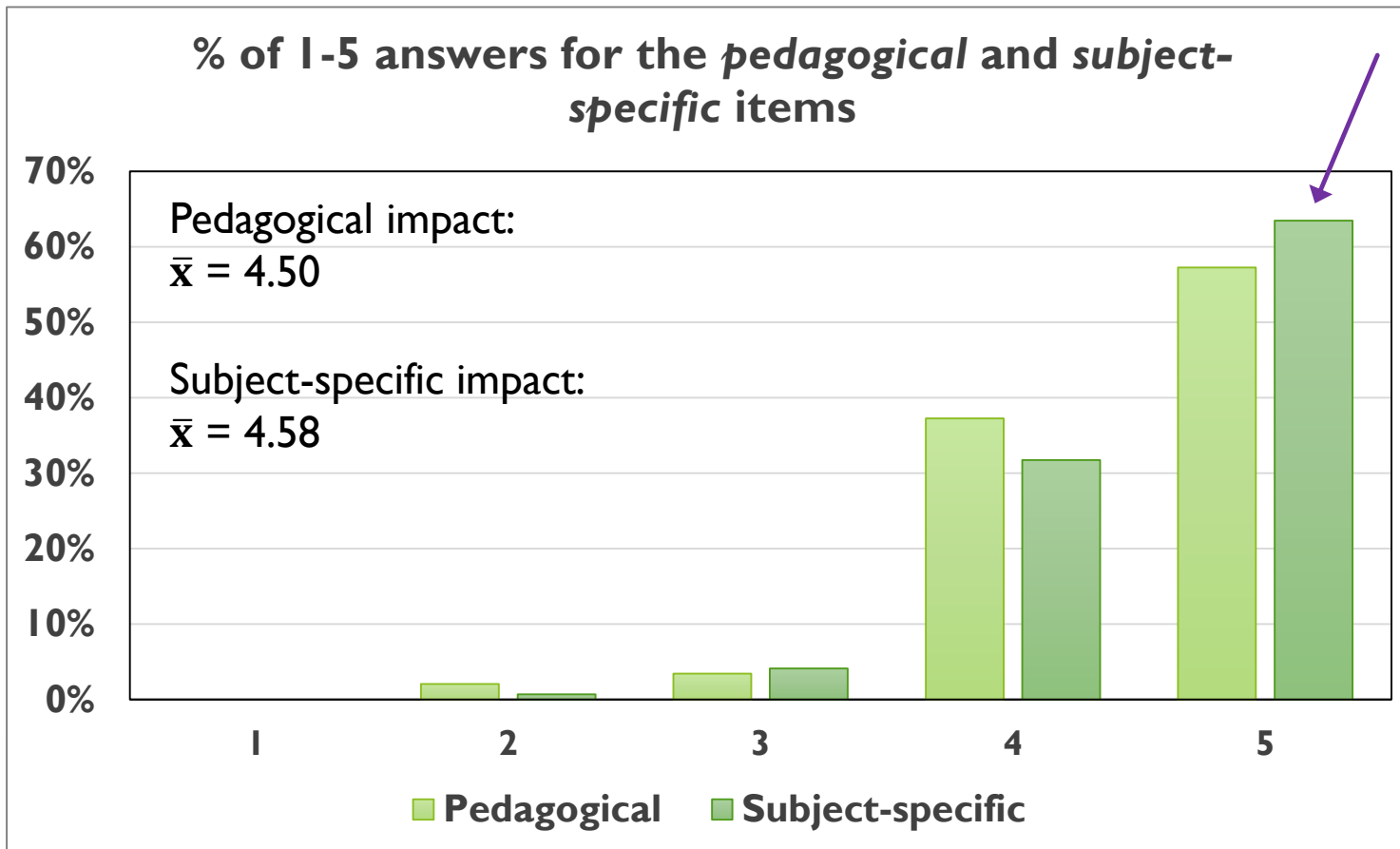
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# Results (I)

## 1. PEDAGOGICAL AND SUBJECT-SPECIFIC IMPACT



$N = 29$  future teachers

- 5 items about pedagogical impact
- 5 items about subject-specific impact

*To what extent do you consider that the project of school workshops between Spain and Peru has allowed you to...?*

# Results (II)

## 1. PEDAGOGICAL AND SUBJECT-SPECIFIC IMPACT

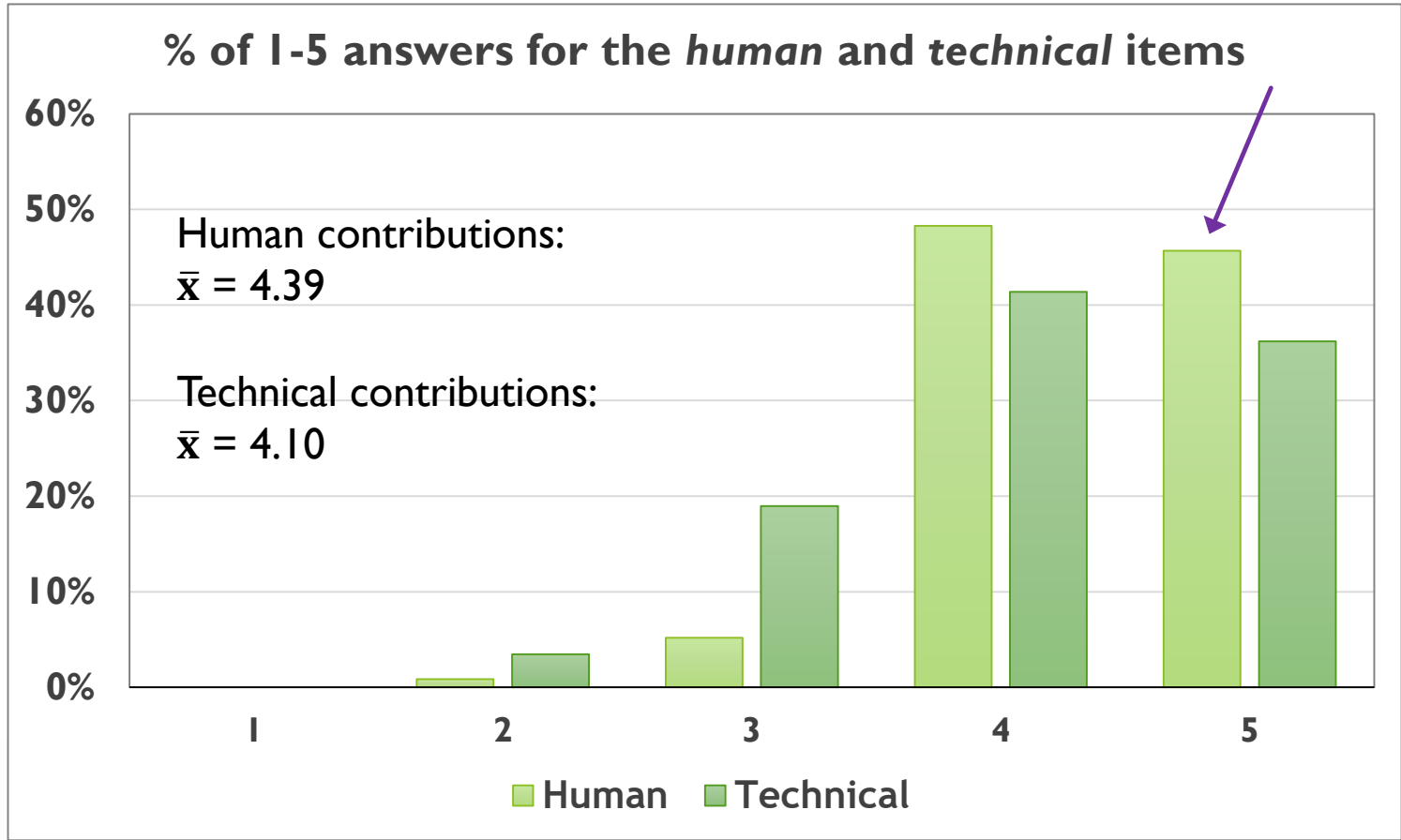
PEDAGOGICAL DIMENSION	Mean	SD
I. <u>Reflect on the own workshops</u> based on the evaluations of the other country (achievements, mistakes, posible changes...).	4.62	0.67
II. Work and interact as a team with a group of future teachers from another country.	4.59	0.62
III. Use digital tools to record and communicate information (video recording and editing, cloud spaces, forums...)	4.52	0.56

SUBJECT-SPECIFIC DIMENSION	Mean	SD
IV. Recognise that similar activities can be carried out with <u>different materials</u> (from everyday life, academics...).	4.66	0.60
V. Identify and reflect on the inquiry-based or applicative (traditional) nature of activities included in the workshops.	4.59	0.56
VI. Improve personal understanding about the contents of electrical circuits / light and colour.	4.52	0.68

(Abril, Romero, Quesada, & Ariza, 2014)

# Results (III)

## 2. HUMAN AND TECHNICAL CONTRIBUTIONS



*N* = 29 future teachers

- 4 items about human contributions
- 4 items about technical contributions

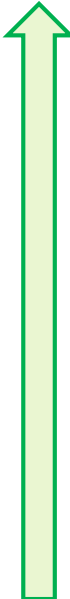
*How much have the following aspects contributed to the proper development of the Project...?*



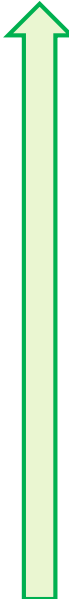
# Results (IV)

## 2. HUMAN AND TECHNICAL CONTRIBUTIONS

### HUMAN ASPECTS

- 
- I. **Professors** from your own country ( $\bar{x} = 4.62$ ).
  - II. The contribution of co-workers (groups) of your same country ( $\bar{x} = 4.41$ ).
  - III. The associated groups (electrical circuits / light and colour) of the other country ( $\bar{x} = 4.31$ ).
  - IV. **Your personal contributions** to the different activities and work sessions ( $\bar{x} = 4.21$ ).

### TECHNICAL ASPECTS

- 
- I. The final session of discussion about the workshops through **videoconference** ( $\bar{x} = 4.45$ ).
  - II. The accessibility to the materials and tools necessary for carrying out the workshops ( $\bar{x} = 4.31$ ).
  - III. The design and tools of the *Schoology* platform ( $\bar{x} = 4.03$ ).
  - IV. The **videos** made by the groups of the other country ( $\bar{x} = 3.62$ ).



Indagative Vs. Applicative nature of workshops. *How are the videos presented?*



# Results (V)

## 3. EVOLUTION IN THE VIEWS ABOUT WORKSHOPS

Future teachers' responses to:

*How has your view on experimental physics workshops evolved as a result of the international project?*

### ATOMISTIC WORKSHOPS

«I used to see them as separate activities from science, which complement the explanation and are "fun" and original because they take you out of the traditional».

### HOLISTIC WORKSHOPS

«But it is not about complementing but providing an explanation about the corresponding concepts through the workshop [...] understanding curricular objectives».

N = 5

### WORKSHOPS TO APPLY KNOWLEDGE

«I used to understand workshops as something guided that simply requires to follow the steps».

### WORKSHOPS TO CONSTRUCT KNOWLEDGE

«As a result of the project, physics experiments seem very productive and fun to me. We ourselves solve them, and this allows us to imagine many things and check them».

N = 3

(Gil et al., 1999)

# Results (VI)

## 3. EVOLUTION IN THE VIEWS ABOUT WORKSHOPS

Future teachers' responses to:

*How has your view on experimental physics workshops evolved as a result of the international project?*

### SIMPLE PLANNING OF THE WORKSHOPS

«It has evolved radically, because at the beginning I thought it would be easy and that we would send a simple experimental workshop. It would just be an experimental guide».

### COMPLEX PLANNING OF THE WORKSHOPS

«But then we had to look for a lot of information on the topic [...] and we also had to revise the curricular design to see what we wanted students to achieve».

N = 5

### WORKSHOPS AS TEACHING OBSTACLES

«Honestly, the idea of doing physics lab activities scared me a little because I've always preferred other types of subjects».

### WORKSHOPS AS TEACHING OPPORTUNITIES

«But now I am very satisfied, and I think that experimentation should be applied in the classroom from primary school to avoid, in this way, prejudices like the ones I had».

N = 2

(Pilitsis &  
Duncan, 2012)



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# Conclusions

- ✓ The project has promoted the development of competencies in future teachers: those specific to science ( $\bar{x} = 4.58$ ) and others of a general nature ( $\bar{x} = 4.50$ )
  - ⇒ The proposal approach has been holistic, through a real professional problem such as designing school workshops on physics.
- ✓ Both human ( $\bar{x} = 4.39$ ) and technical ( $\bar{x} = 4.10$ ) contributions to the project have been valued very positively.



# Conclusions

- ✓ Future teachers evolve in their views about the nature of inquiry-based workshops towards a more complex model.
  - ⇒ Future teachers consider their constructivist character, which incorporates scientific practices and integrates theory and practice to deal with science topics. This model also refers to the complex design and planning of workshops.
- ✓ The perception of a variety of activities, materials or approaches to design inquiry-based workshops is a clearly positive result, especially when they are still infrequent in school classrooms.





**Thank you for your attention!**

