

# Inteligencia Artificial para el Aprendizaje de Idiomas

Diseño y efectividad de sistemas de diálogo y chatbots

Serge Bibauw

Club de Investigadores, 22 sept. 2022



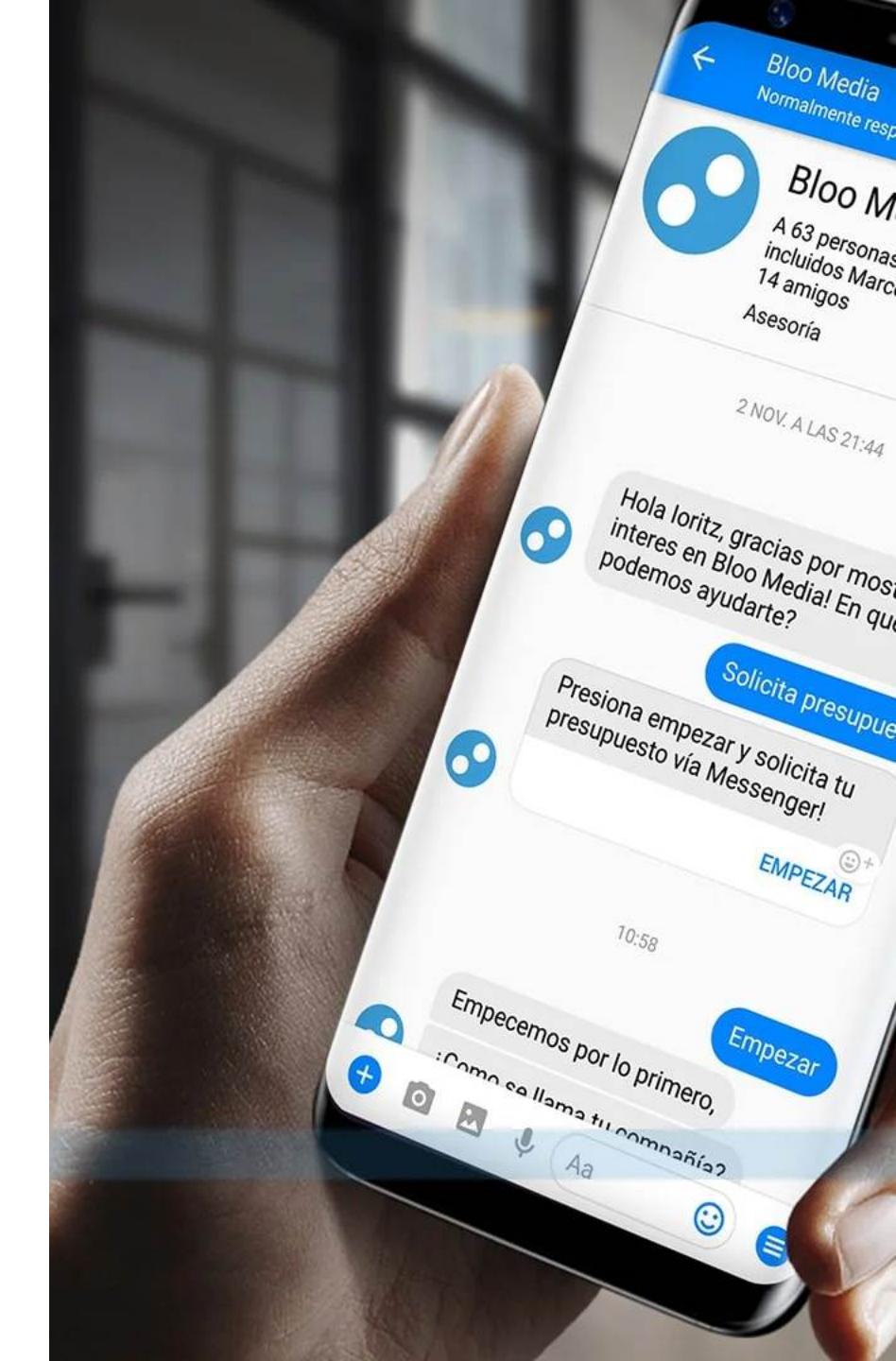
# Inteligencia artificial?

- No hay mucha “inteligencia”
- Agentes “inteligentes” = “cualquier sistema que percibe su entorno y realiza acciones que maximizan sus posibilidades de alcanzar sus objetivos” (Wikipedia EN)
- Engloba
  - carros autoconducidos (Tesla)
  - toma de decisiones automatizada...
  - procesamiento de lenguaje natural (NLP)
    - reconocimiento vocal...
    - sistemas de dialogo



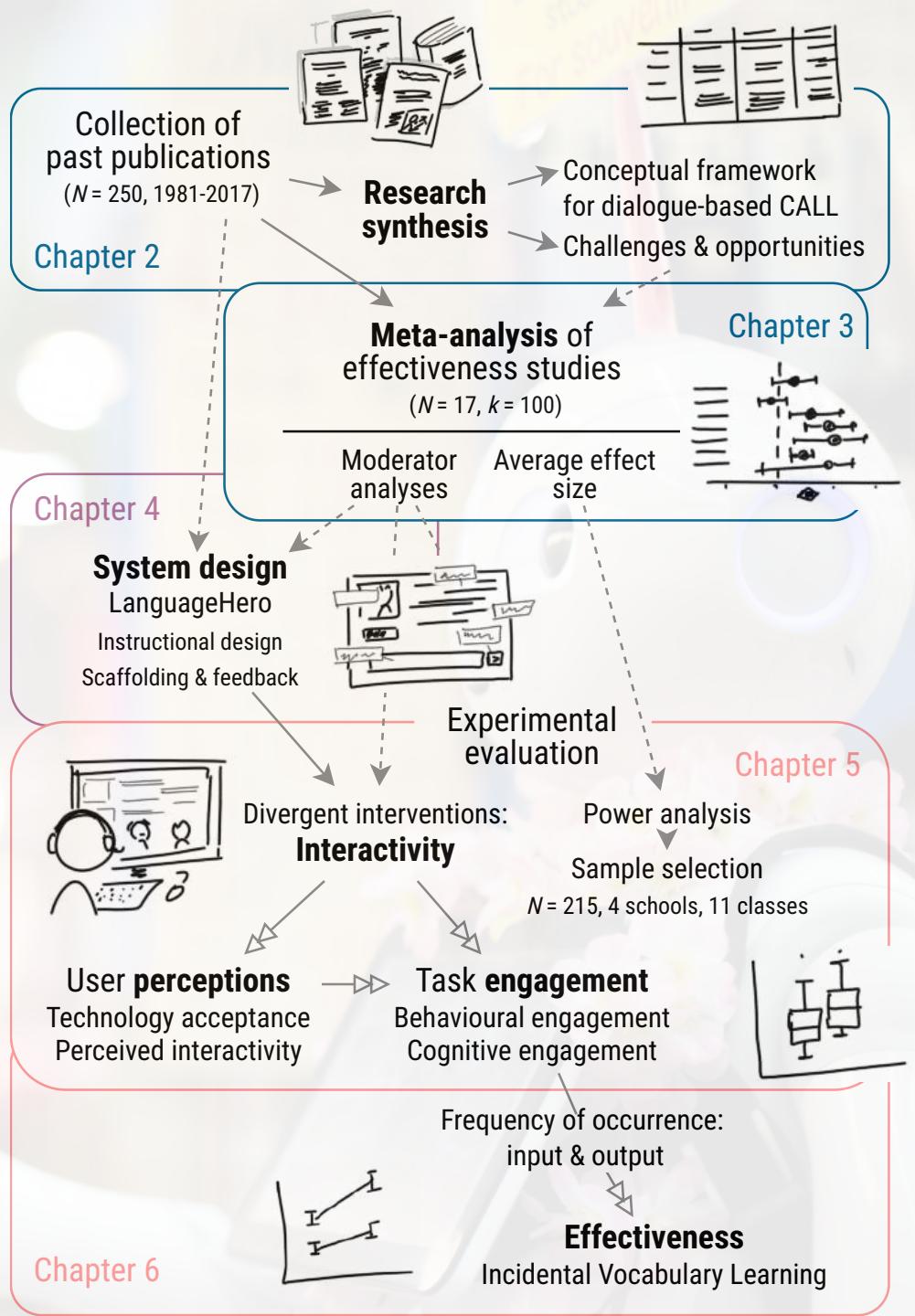
# IA conversacional

- Agentes “inteligentes” conversacionales =
  - chatbots (ELIZA, bots en WhatsApp/Messenger)
  - sistemas de diálogo (vocales o +)
  - robots parlantes
  - asistentes personales inteligentes (Siri, Google Assistant...)
  - parlantes inteligentes (Alexa) ...



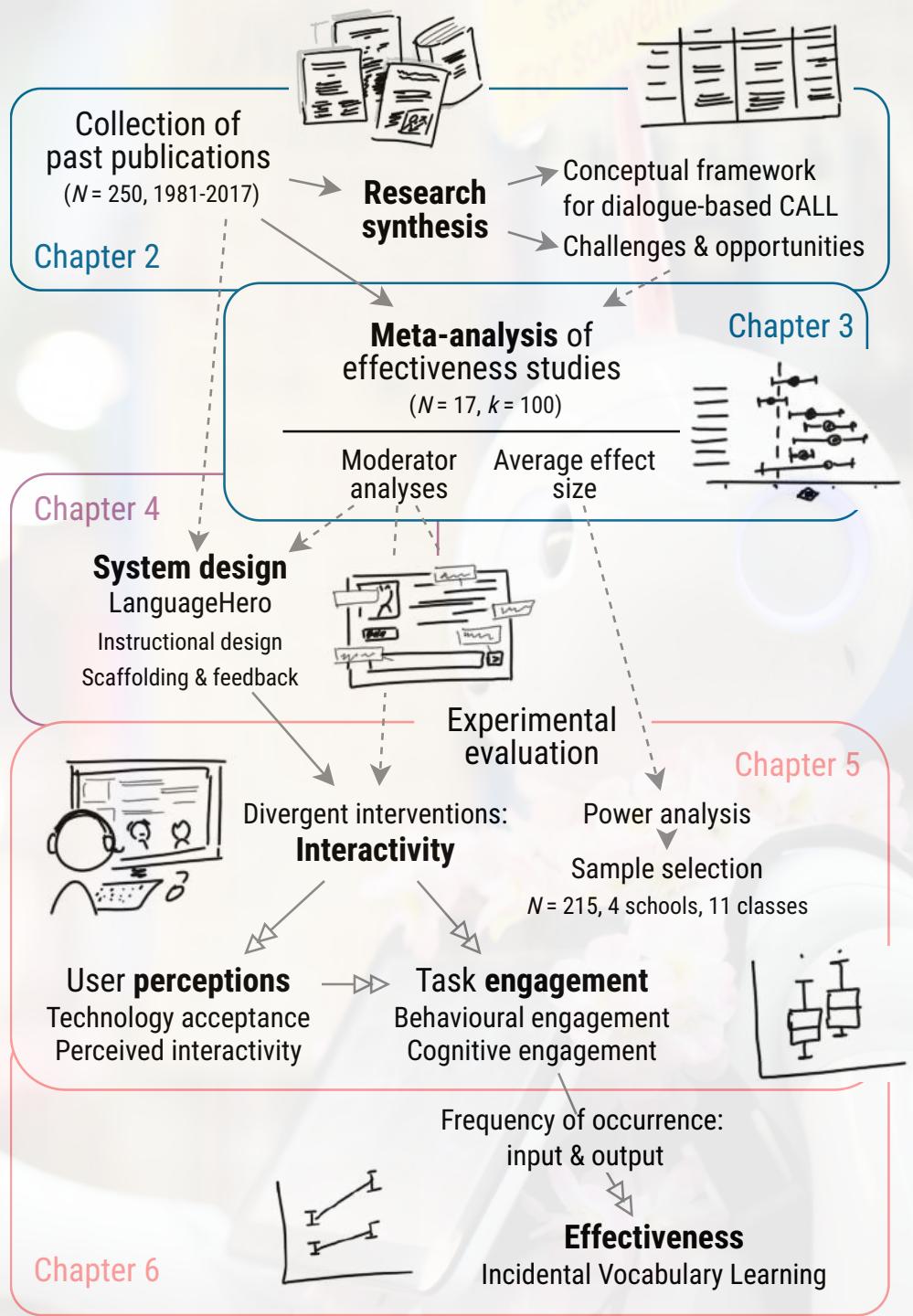
# IA y aprendizaje de idiomas

1. Estado de la cuestión
2. Marco conceptual
3. Efectividad
4. Interactividad y output
5. Limitaciones y perspectivas



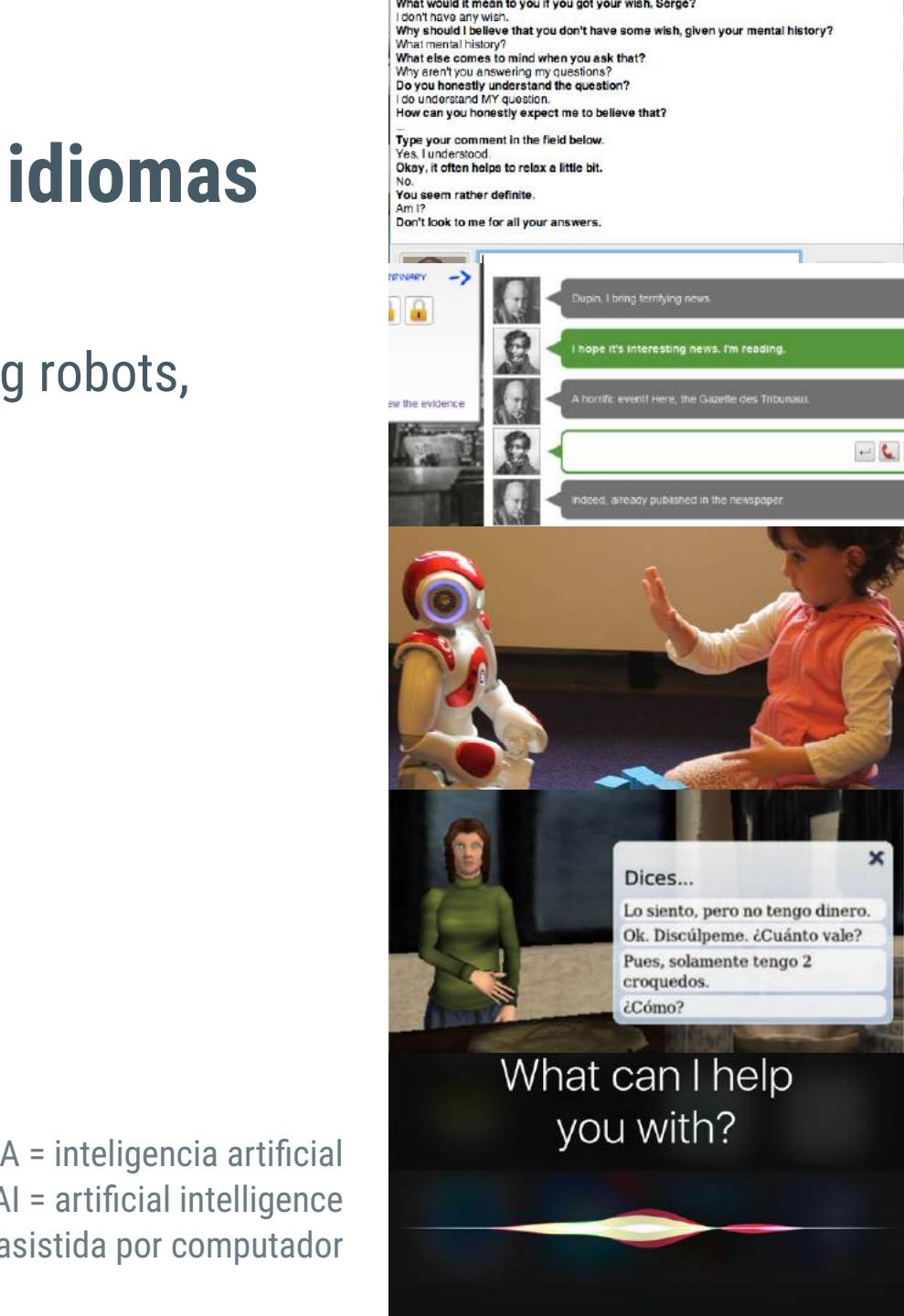
# IA y aprendizaje de idiomas

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# IA conversacional para el aprendizaje de idiomas

- **IA conversacional =**  
chatbots, conversational agents, dialogue systems, talking robots, intelligent personal assistants, smart speakers...
- **Dialogue-based CALL =**  
IA conversacional aplicada al aprendizaje de idiomas  
(extranjeros/segundos)



IA = inteligencia artificial  
AI = artificial intelligence

CALL = computer-assisted language learning = enseñanza de lenguas asistida por computador

# Un gran potencial para el aprendizaje de L2...

- Práctica productiva enfocada en el mensaje  
(Gass & Mackey, 2015; Muranoi, 2007)
- Accesible para contextos extranjeros (Sydorenko et al, 2019)
- Baja ansiedad (Alemi et al, 2015; Ayedoun et al, 2015)
- Complejidad adaptativa (potencialmente)
- Retroalimentación (*feedback*) y andamiaje automáticos (Petersen, 2010; Wilske, 2015)



L2 = lengua segunda/extranjera

# ...pero en necesidad de evidencia

## 1. Una laguna teórica en CALL

¿Qué conceptos y estructuras para la diversidad de sistemas?

- ⇒ Marco conceptual y tipología

## 2. Una laguna empírica en CALL conversacional

¿Qué efectividad tienen los distintos tipos de sistemas?

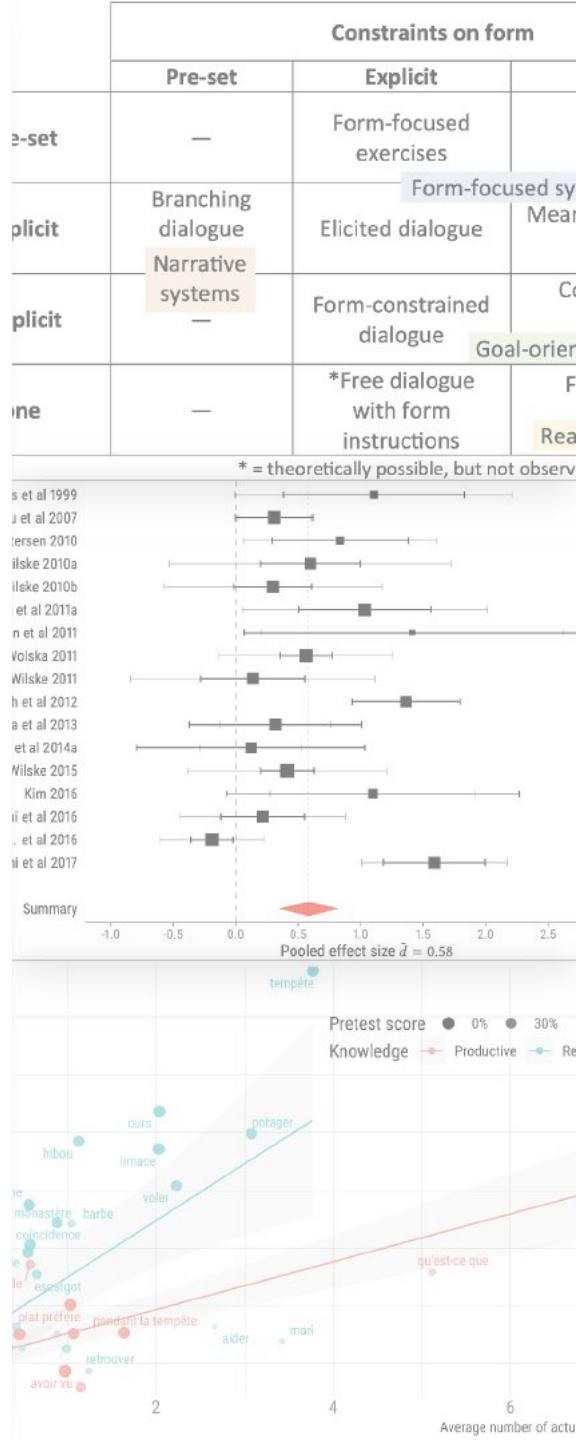
- ⇒ Meta-análisis + Estudio de efectividad comparativa

## 3. Una laguna empírica en el SLA

¿Qué papel del output e interactividad en el aprendizaje de L2?

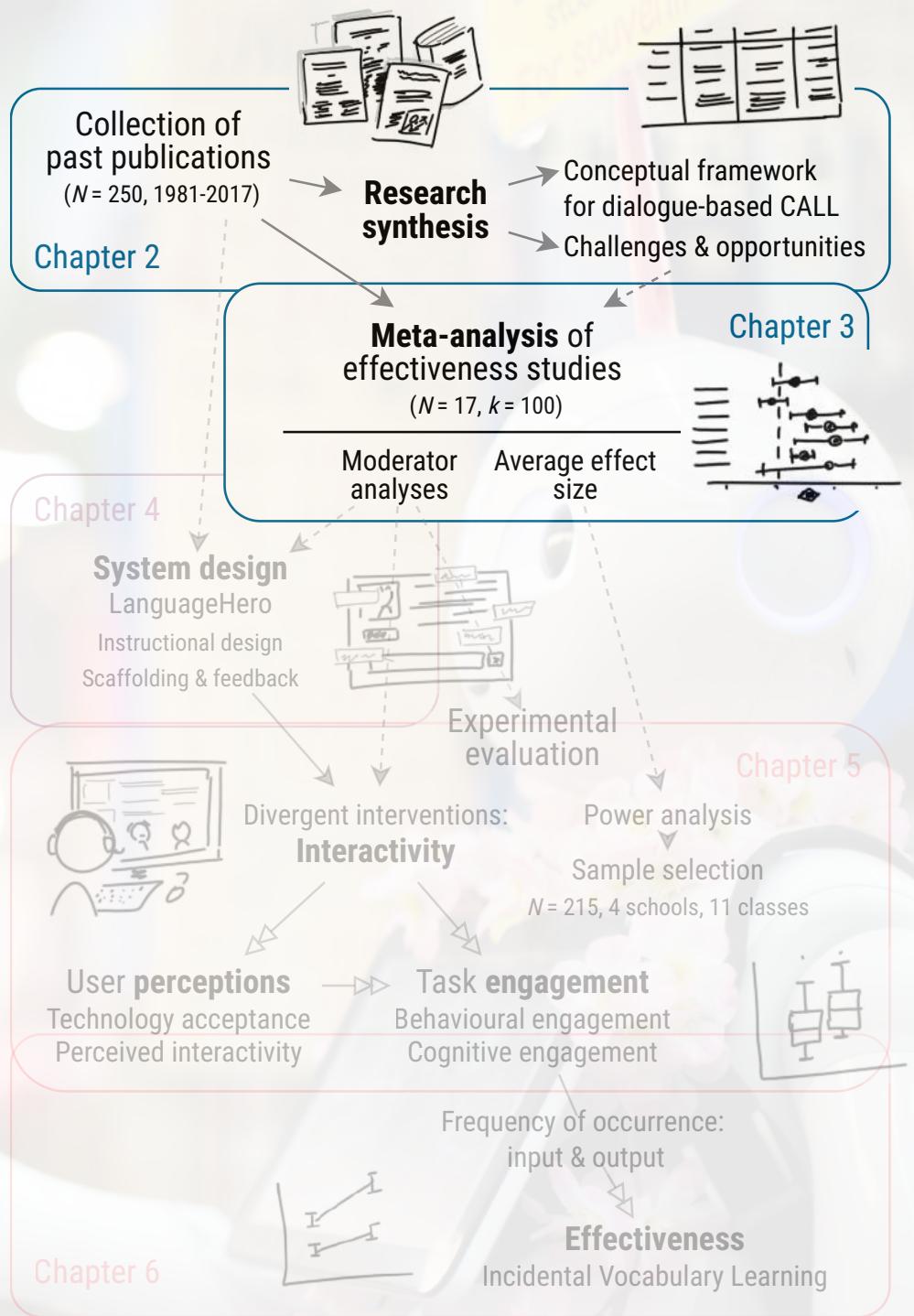
- ⇒ Aislar los efectos de la interactividad y el output

SLA = second language acquisition = aprendizaje de idiomas extranjeros



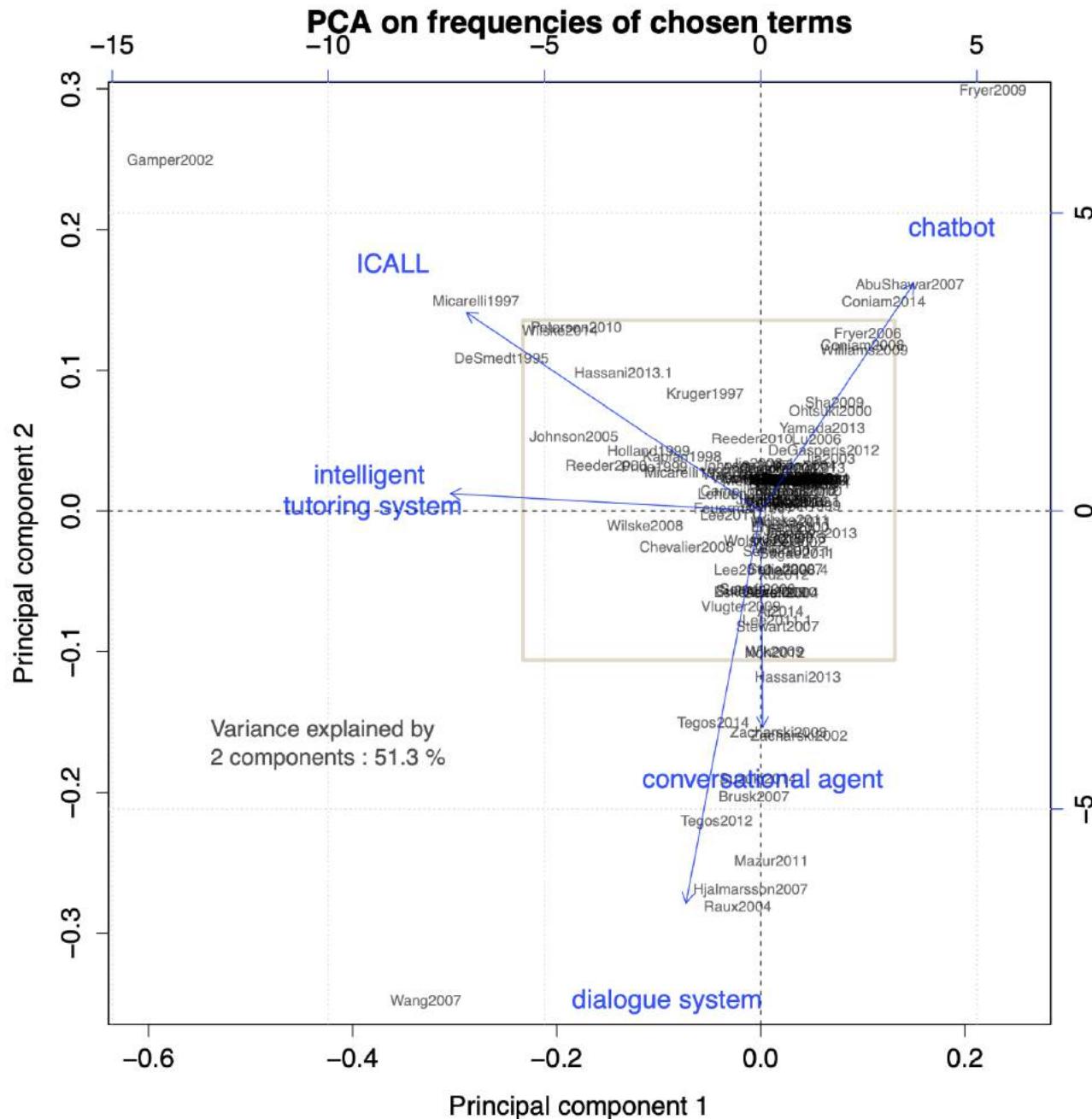
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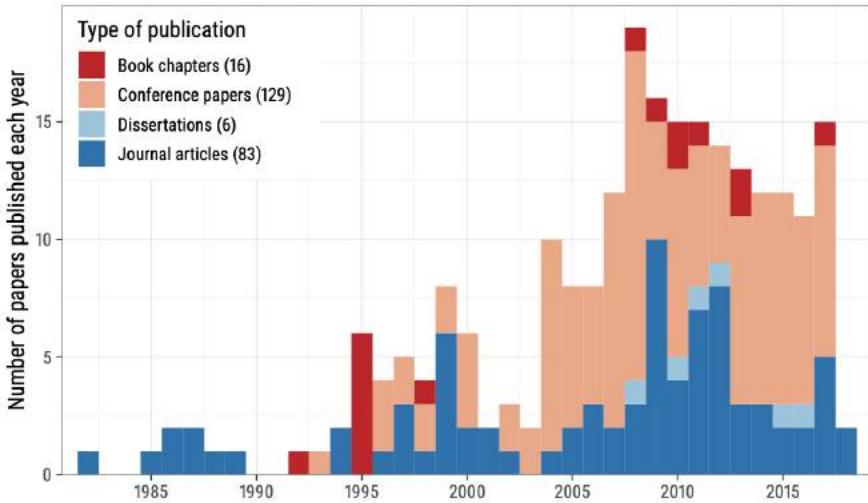
# Revisión de la literatura: un campo fragmentado

- Investigación agrupada por palabras clave/tecnología:
  - chatbots
  - sistemas de diálogo/tutoriales
  - robots...
- División histórica más que basada en diferencias de uso (*affordances*)

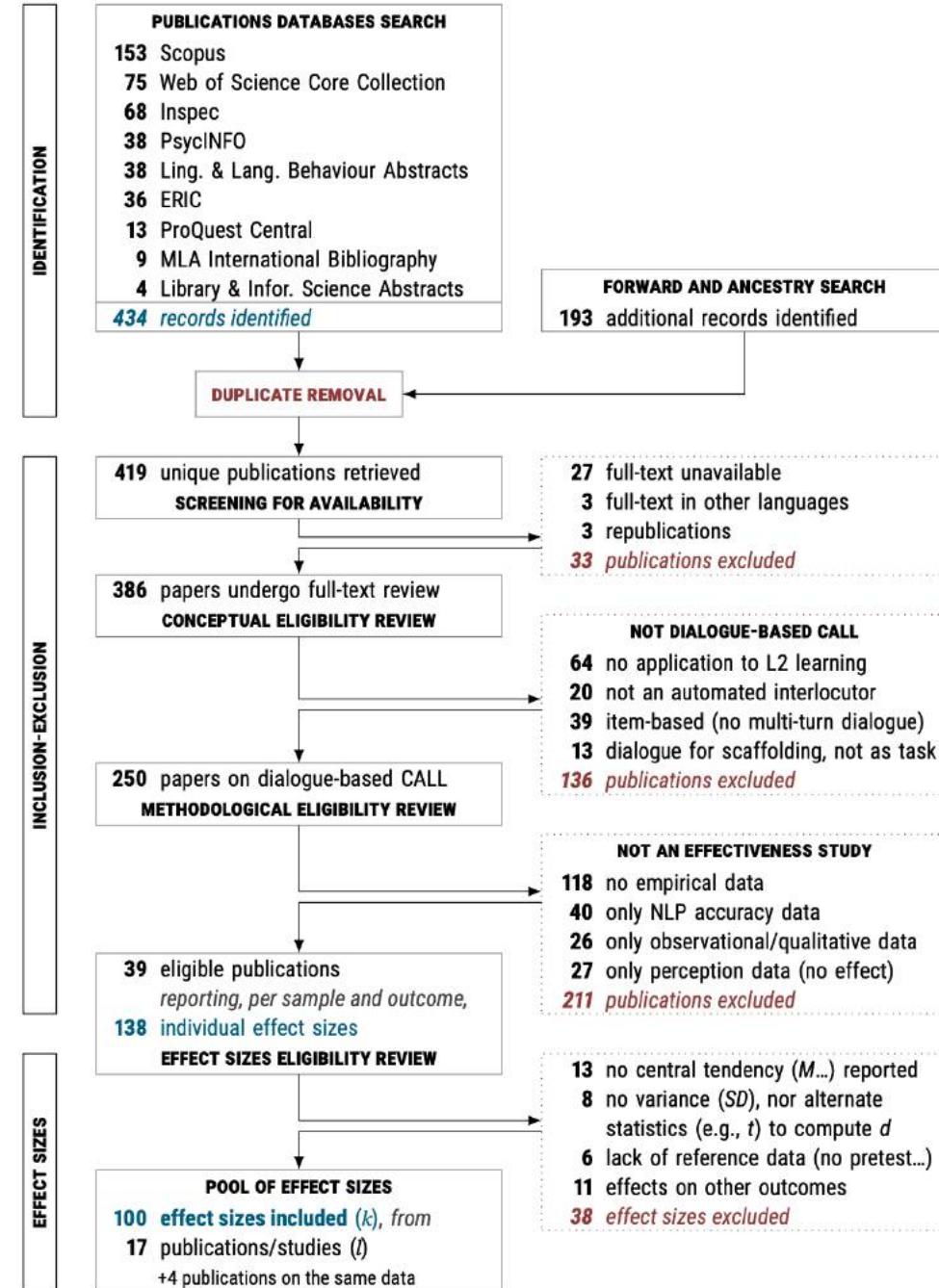


# Revisión de la literatura: metodología

- Recolección de datos sistemática
- ⇒ 419 publicaciones identificadas (1982-2018)



- → Marco conceptual emergente (*bottom-up*)



# Marco conceptual: definición operacional

- **CALL conversacional** (*Dialogue-based CALL*)

= cualquier sistema que permita

- tener un **diálogo**
- en la **L2**
- con un **agente automático**
- para el **aprendizaje de la L2**

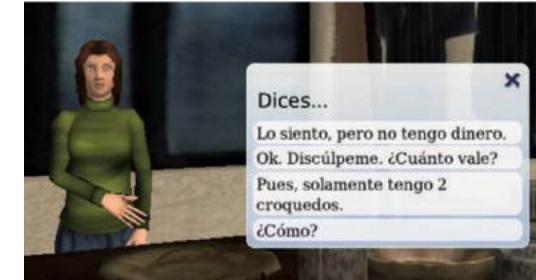
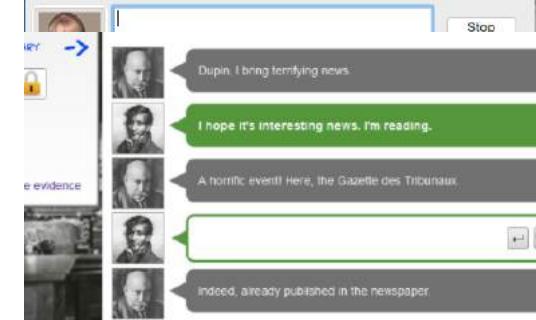
≠ CALL tutorial basados en ítems

≠ agentes pedagógicos

≠ chat/videoconferencia

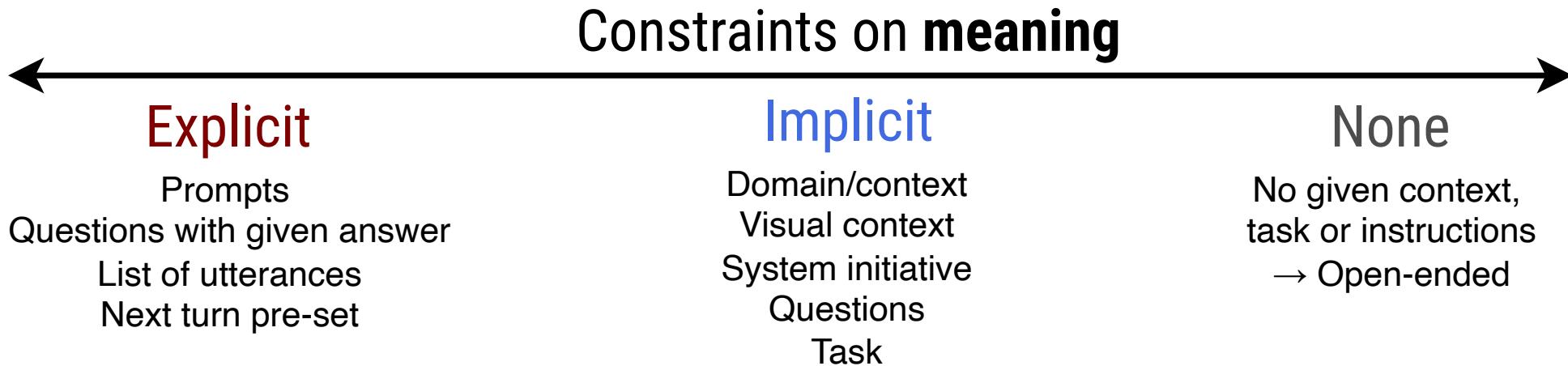
≠ sistemas de diálogo en general

I'd like to talk about the weather.  
What would it mean to you if you got your wish, Serge?  
I don't have any.  
Why should I believe that you don't have some wish, given your mental history?  
What's missing in today?  
What else comes to mind when you ask that?  
Why aren't you answering my questions?  
Do you honestly understand the question?  
I do understand MY question.  
How can you honestly expect me to believe that?  
Type your comment in the field below.  
Yes, I understood.  
Okay, it often helps to relax a little bit.  
No,  
You seem rather definite.  
Am I?  
Don't look to me for all your answers.

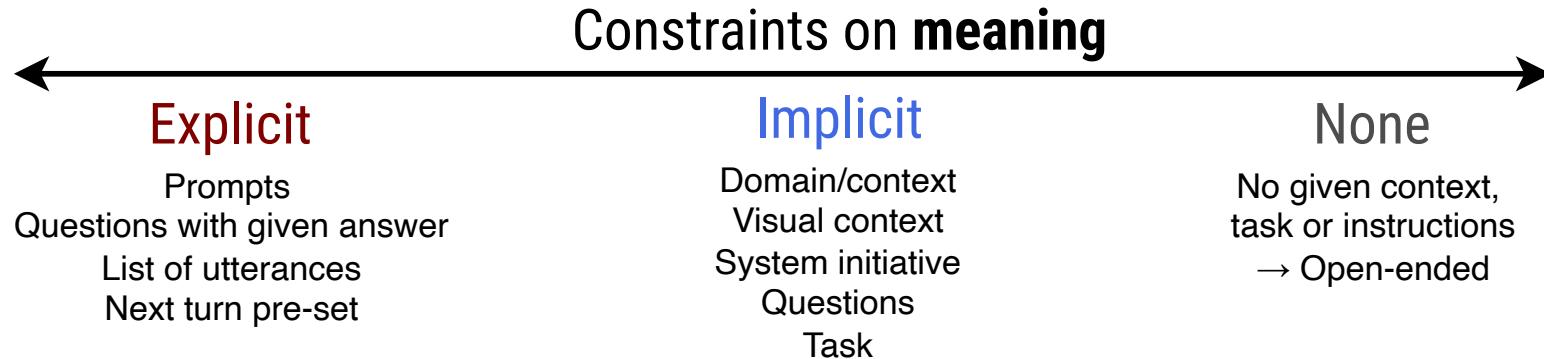


What can I help  
you with?

# Marco conceptual: tipología de sistemas



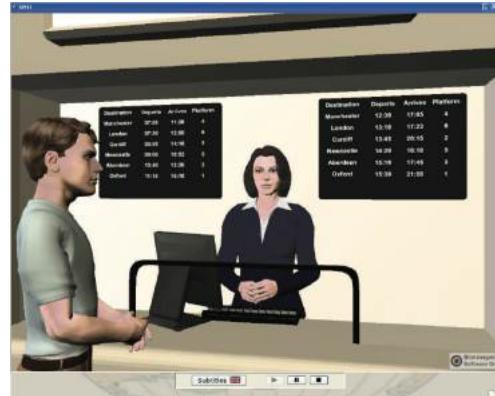
# Marco conceptual: tipología de sistemas



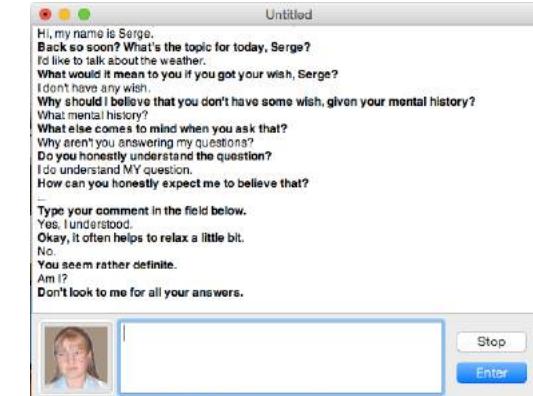
## Form-focused system



## Goal-oriented system



## Reactive system



# Síntesis de investigación

- Implicaciones interactivas, instructivas y tecnológicas de la tipología
- Síntesis de evidencias empíricas



Published (2019) in *Computer Assisted Language Learning, 32(8)*.



Also discussed (2022) in *The Routledge Handbook of SLA & Technology*.

COMPUTER ASSISTED LANGUAGE LEARNING  
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<http://doi.org/10.1080/08856266.2022.155048>

Routledge  
Taylor & Francis Group

 Discussing with a computer to practice a foreign language: research synthesis and conceptual framework of dialogue-based CALL

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**ABSTRACT:** This article presents the results of a systematic review of the literature on dialogue-based CALL, resulting in a conceptual framework for research on the topic. Agents allowing a learner to practice a target language by discussing with a computer have been studied from various perspectives and have been used in various applications (e.g., L1/L2 translation, grammar, pronunciation, reading, writing, listening, and oral communication). Considering the fragmentation of what we identify under the term dialogue-based CALL, one of the main goals of this article is to propose a conceptual framework for research on dialogue-based CALL. Through a methodical search strategy, we collected a corpus of 111 relevant studies. The article first presents the operational definition of dialogue-based CALL, which allowed us to identify 56 relevant papers. Subsequently, we present the conceptual framework in terms of continuous evolution and research. We propose to divide those systems into four groups. We have called them *task-oriented*, *instructional*, *simulation*, and *game-oriented* systems, and we describe their corresponding instructional approaches. Finally, we present the main findings of our systematic review. These findings are based on the main results from empirical studies on such systems, distinguishing observational, survey and experimental studies, and are organized according to the four groups of dialogue-based CALL development, identifying positive evidence on each outcome. Finally, we present two new areas for future research: the integration of dialogue-based CALL approaches and dialogue systems as an environment for testing SLA hypotheses.

**KEYWORDS:** Task-oriented, Instructional, Simulation, Game-oriented, CALL, Research, SLA, Hypotheses, Evidence

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**SYSTEMS & LEARNING Beyond**  
Edited by Pieter Demeester

**REFERENCES**  
Bibauw, S., François, T., & Demeester, P. (2019). Discussing with a computer to practice a foreign language: research synthesis and conceptual framework of dialogue-based CALL. *Computer Assisted Language Learning, 33*(9), 827-873. doi:10.1080/08856266.2022.155048

Bibauw, S., François, T., & Demeester, P. (2022). Discussing with a computer to practice a foreign language: research synthesis and conceptual framework of dialogue-based CALL. In P. Demeester (Ed.), *The Routledge handbook of SLA & technology* (pp. 33–54). Routledge.

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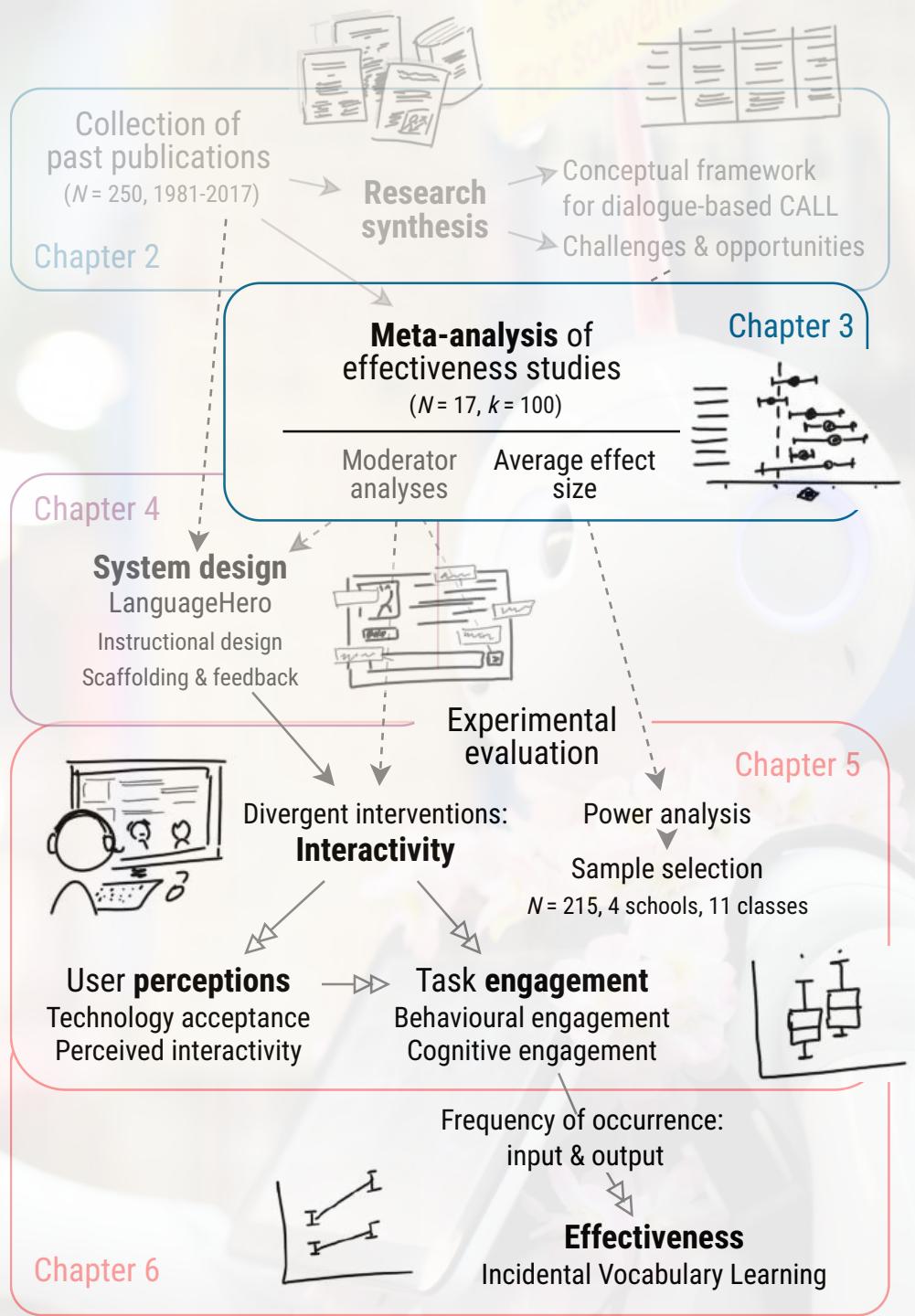
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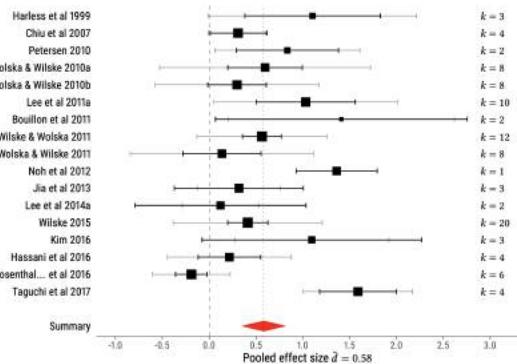
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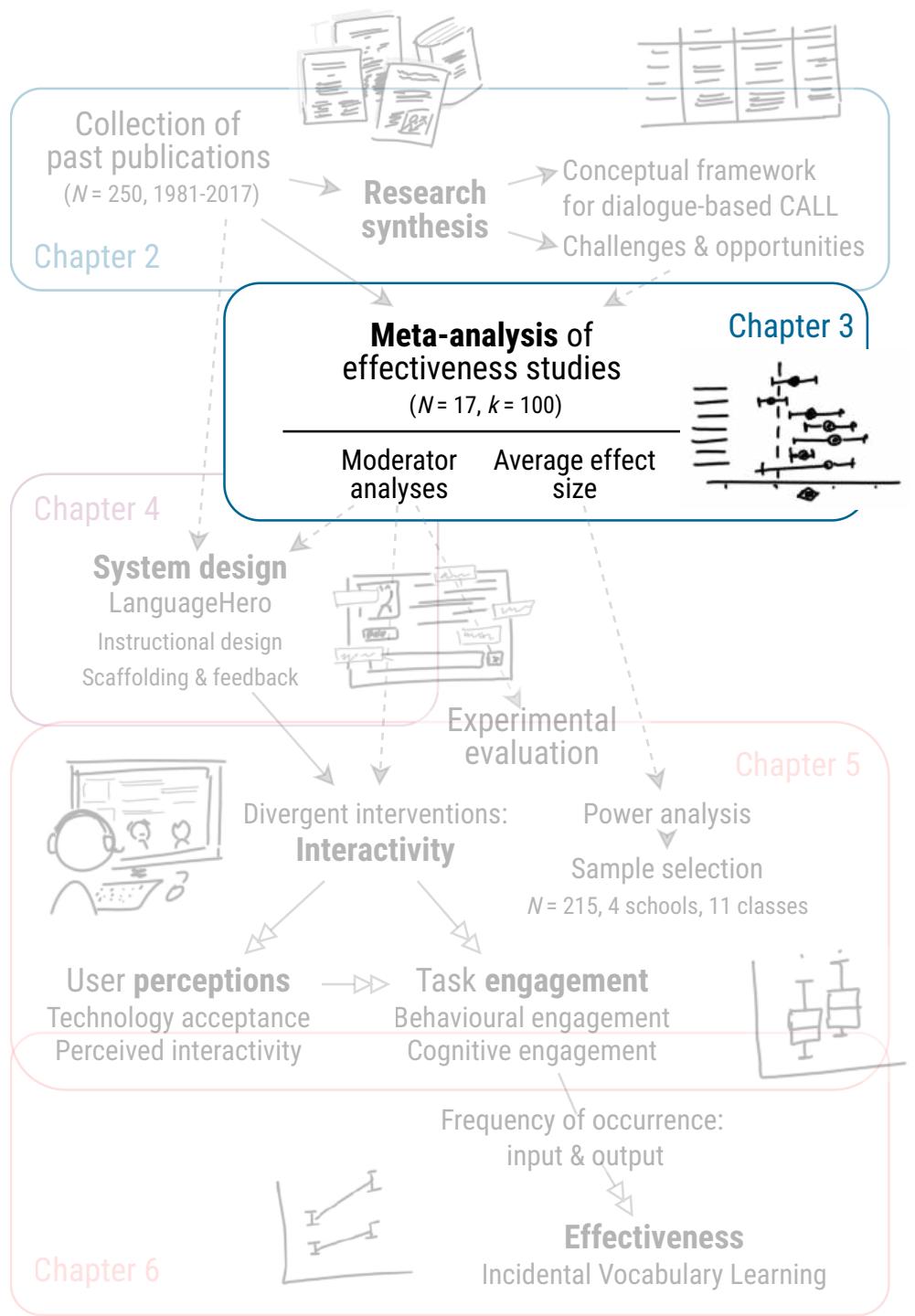


# Efectividad: Evidencia previa

- **Meta-análisis de estudios de efectividad**
- ⇒ **17 estudios, 100 efectos**
- ⇒ Efecto promedio de  $d = 0.58$  (medio)



- Comparable (pero menor) a los efectos de las interacciones entre humanos  
(Lin, 2015; Ziegler, 2016; Mackey & Goo, 2007)



# Efectividad relativa: Análisis de moderadores

- **Tipo de sistema:** ✓ Form-focused    ✓ Goal-oriented
- **Características instruccionales:** ✓ Retroalimentación correctiva (Petersen, 2010; Wilske, 2015)
- **Interacciones:** ✓ Guiado por el sistema & Pre-establecido
  - → Restringiendo mensajes para focalizarse en la instrucción?
  - → ¿Interacciones más libres y contextualizadas beneficiosas?  
¿Qué pasa con las percepciones de los alumnos? ¿La motivación?

Language Learning & Technology  
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ARTICLE

Dialogue systems for language learning:  
A meta-analysis

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Wim Vanhoutte, Maastricht University, Maastricht University  
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Piet Deunst, KIT Leiden, Utrecht University

**Abstract**

This review study offers a systematic synthesis of effectiveness studies on dialogue-based CALL, concerning dialogues between a learner positioned in a foreign language (L2) to interact with a conversational agent ("it's me"). Through a systematic inclusion and exclusion process, we identified 17 relevant meta-analyzable studies. We make use of Mertler and Jöckel's (2002) framework to examine the comparative effect sizes across length, involving L1 and L2, and the presence or absence of a conversational agent. The results show that dialogue-based CALL practice had a significant medium effect size on L2 proficiency development ( $M = 0.30$ ). We performed separate moderator analyses to explore the relative effectiveness of different dialogue types (e.g., guided, conversational, corrective, feedback, argumentative, question-and-answer, available, corrective, feedback, argumentative, question-and-answer). Our study confirms the effectiveness of form-focused and goal-oriented systems, system-guided interactions, corrective feedback provision, and question-and-answer interactions. In addition, our results show that the effect of dialogues on L2 vocabulary, L2 dictation proficiency, and accuracy are negligible. Finally, we discuss specific criticisms of dialogue-based CALL and the language learning conversation it offers.

**Keywords:** Meta-analysis, Dialogue Systems, Chatbot, Dialogue-based CALL

**APA Citation:** Blaauw, S., Van den Noortgate, N., Frings, F., & Deunst, P. (2022). Dialogue systems for language learning: A meta-analysis. *Language Learning & Technology*, 26(1), 1–24. [https://doi.org/10.1207/S1082967XLLT2601\\_01](https://doi.org/10.1207/S1082967XLLT2601_01)

**Introduction**

The central aim of this study is to evaluate the effectiveness of dialogue-based computer-assisted language learning (CALL) for second- or foreign language (L2) learners. Dialogue-based CALL encompasses all applications that involve the participation of a learner and a conversational agent. This conversational agent can be a videoconferencing virtual assistant, a computer-controlled character, or a physical robot. Recently, with the increasing prevalence of chatbots and digital personal assistants, a new definition has been proposed for dialogue-based CALL, which refers to the use of conversational agents in real-world applications as being developed for education. Dialogue Web was released in 2016. Yet, because of the type of questions that were asked, the term "chatbot" is more appropriate than "dialogue-based CALL". The application has an impact on the development of L2 proficiency, as it is commonly assumed by the proponents of these systems, and thus instructional and user design characteristics moderate the size of these gains.

**Dialogue-based CALL**

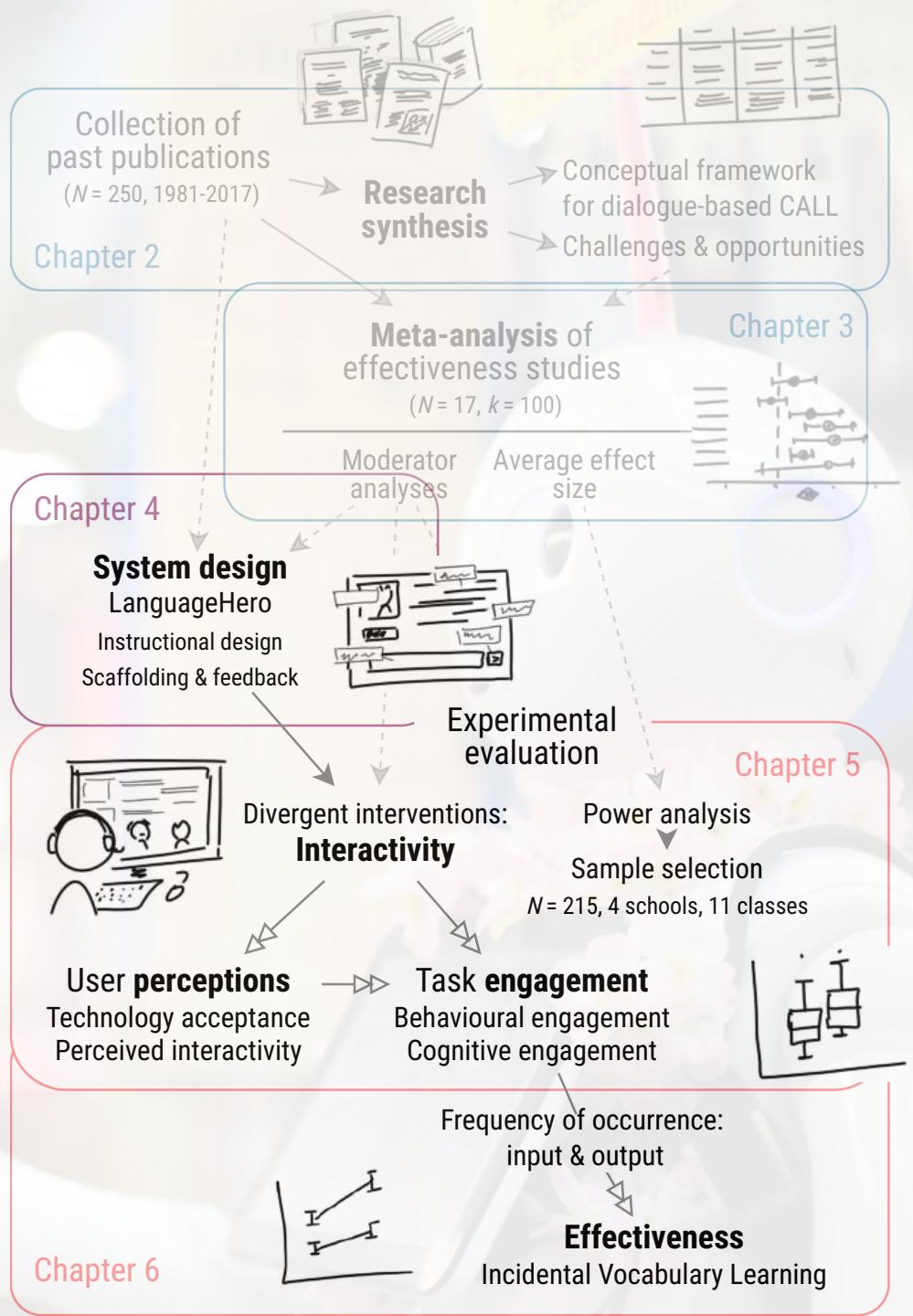
Many studies have been done on systems implementing dialogue interactions with an automated agent in



Published (2022) in *Language Learning & Technology*, 26(1).

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# Estudio de efectividad: experimento



- ¿Cómo se comparan las interacciones de diálogo interactivas (libres) y estáticas (fijas)?
- Experimento multisitio: 4 escuelas, 11 clases, 215 estudiantes flamencos de francés (~13 a.)
- Sistema: 2 versiones de *LanguageHero* (Linguineo, 2018-...)

## Sistema de diálogo interactivo

Conversation: The snails - Vincent - Get to know the snails family

Score: 423 ? Friendship IVD: Acquaintance

Current task (2/30): Say it is nice to meet them.

Type or say your answer: Type text... Send your reply

We can give you suggestions you can use to come up with an answer:

He: Bien le bonjour! Comment t'appelles-tu?

You: bonjour, je m'appelle Rinc.

He: Enchanté de faire ta connaissance, Rinc! Rinc. Rinc. Rinc. Ne t'en fais pas, je ne suis pas fou. C'est juste que je répète ton nom pour ne pas l'oublier.

You: Comment tu t'appela?

He does not seem to have heard you...

You: Tu t'appelle comment?

Correction: appelle - Vérifiez l'accord entre le pronom « Tu » et le verbe « appelle ». Task accomplished: Good. That was what we were wondering about.

He: Moi, c'est Vincent. Elle, là-bas, c'est Angélique. Ça, c'est Delphine. Puis on a Georges dans le coin. Et évidemment, on ne peut pas oublier les triplées : Lisette, Claudette et Yvette. Ohi! Et puis le petit là-bas, c'est Louis.

Disable help End conversation

## Compleción de diálogo estático

Conversation: The snails - Vincent - Get to know the snails family

Task: Say it is nice to meet them.

He: Ah, vraiment? C'est aussi ce que l'ours a dit! Mais après, il oublie nos prénoms et nous traite de limaces! Des LIMACES! Tu imagines? Si tu es si content de nous connaître, alors tu peux me répéter nos prénoms! Ah! Tu vois! Tu t'en souviens pas, hein?! Désolé, c'est pas de ta faute, petit, mais personne ne fait jamais attention à nous.

Type tekst... Send your reply

Quit

## t - Get to know the snails family

▶ He: Bien le bonjour! Comment t'appelles-tu?

✓ You: bonjour, je m'appelle Rinc

▶ He: Enchanté de faire ta connaissance, Rinc! Rinc. Il  
fou. C'est juste que je répète ton nom pour ne pas

You: **Comment tu t'apele?**

**He does not seem to have heard you...**

✓ You: Tu t'**appelle** comment?

Correction: appelle - Vérifiez l'accord entre le pronom et le nom.

Task accomplished: Good. That was what we were

▶ He: Moi, c'est Vincent. Elle, là-bas, c'est Angélique  
dans le coin. Et évidemment, on ne peut pas oublier  
Yvette. Oh! Et puis le petit là-bas, c'est Louis.

Type or say your answer:

Type text..

We can give you suggestions you can use to come up with:

## cent - Get to know the snails family

▶ He: Bien le bonjour ! Comment t'appelles-tu ?

✓ Je m'appelle Rinc

▶ He: Enchanté de faire ta connaissance, Rinc! Rinc. Il  
pas fou. C'est juste que je répète ton nom pour ne pas

✗ Coment tu t'apele?

▶ He: Moi, c'est Vincent. Elle, là-bas, c'est Angélique. Ça  
Georges dans le coin. Et évidemment, on ne peut pas  
Claudette et Yvette. Oh! Et puis le petit là-bas, c'est L

?

Typ tekst..

💡 Task: Say it is nice to meet them.

▶ He: Ah, vraiment! C'est aussi ce que l'ours a dit! Mais  
nous traité de limaces! Des LIMACES!? Tu imagines? Si  
connaitre, alors tu peux me répéter nos prénoms? Ah:  
hein?! Désolé, c'est pas de ta faute, petit, mais personne  
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?

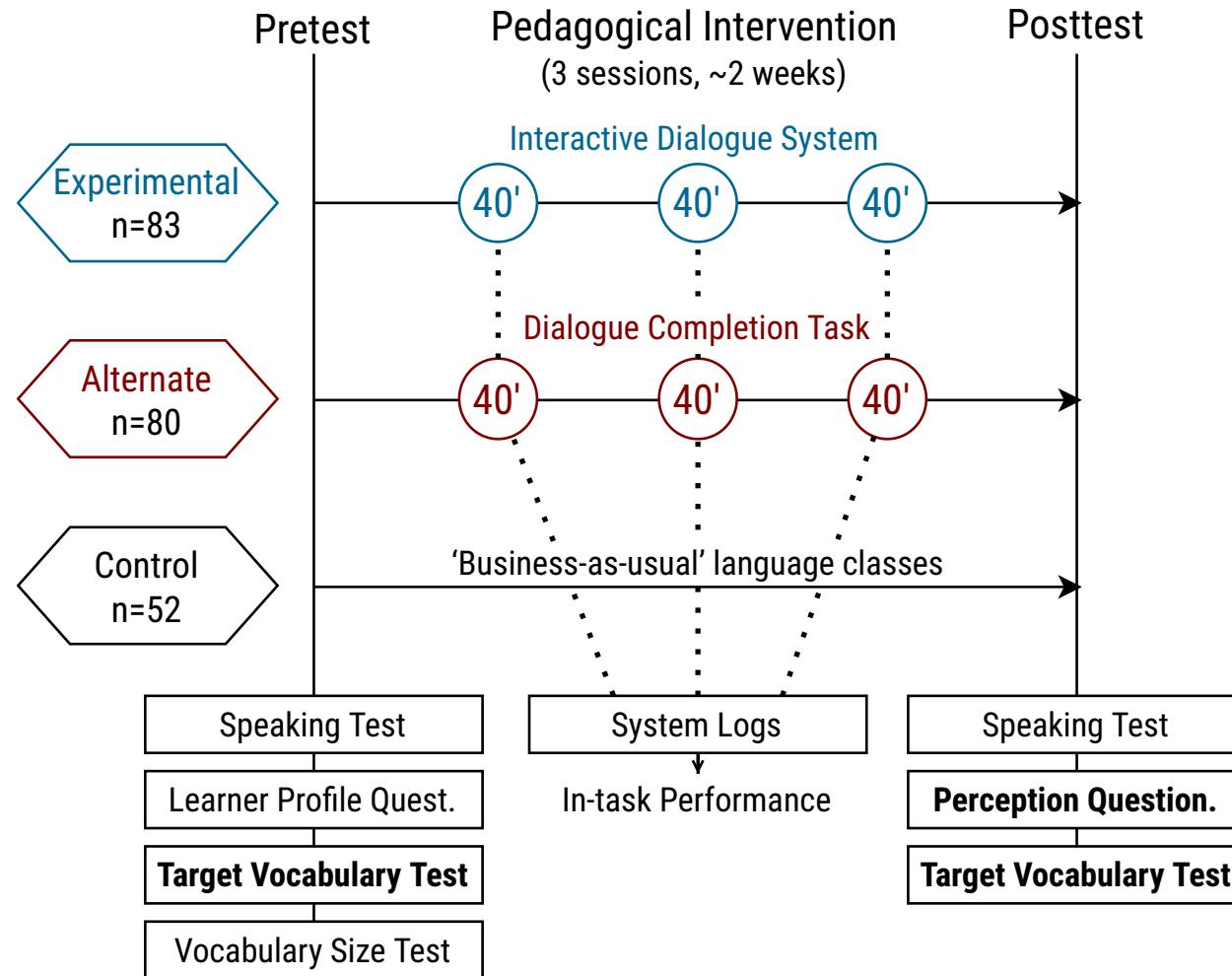
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# Estudio de efectividad: diseño experimental

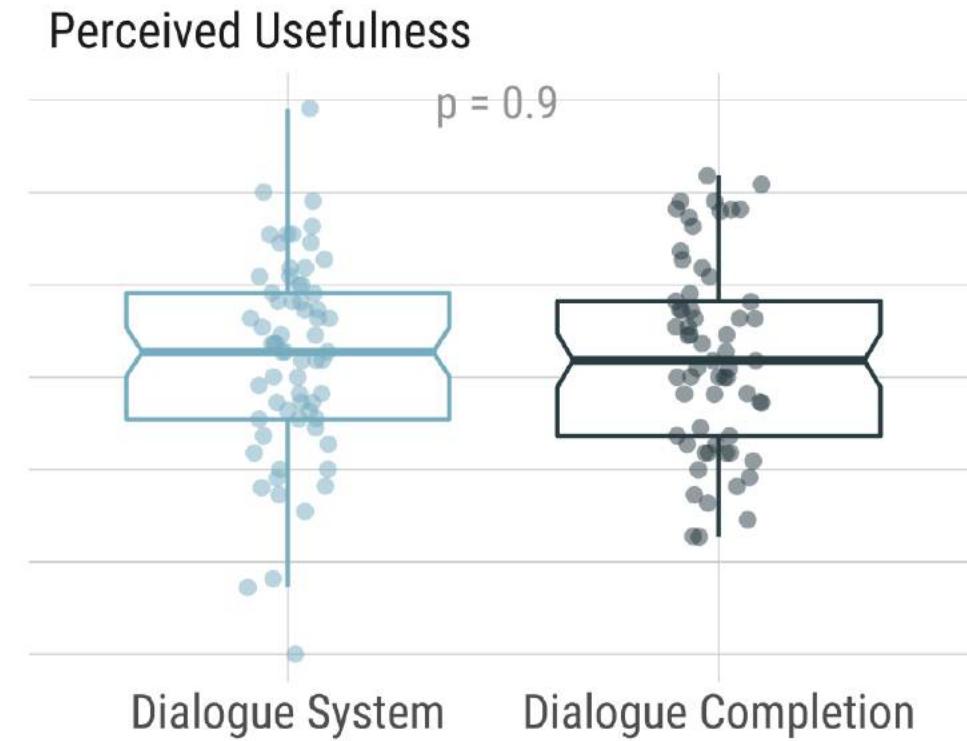
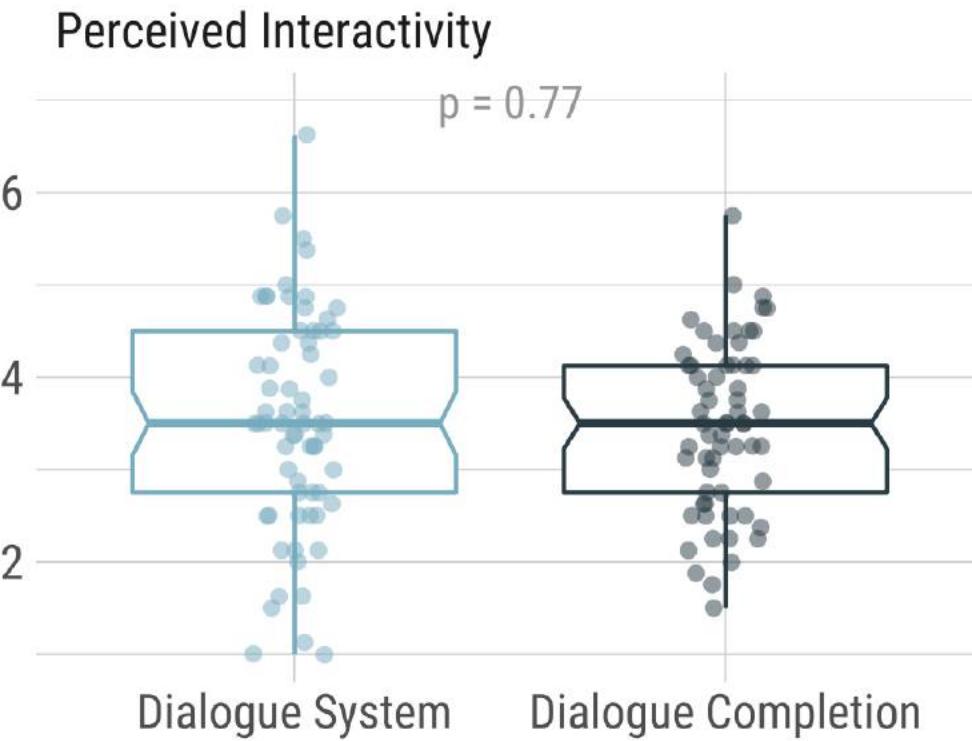


- Resultados:
  - Percepciones
  - Participación (*Engagement*)
  - Aprendizaje del vocabulario



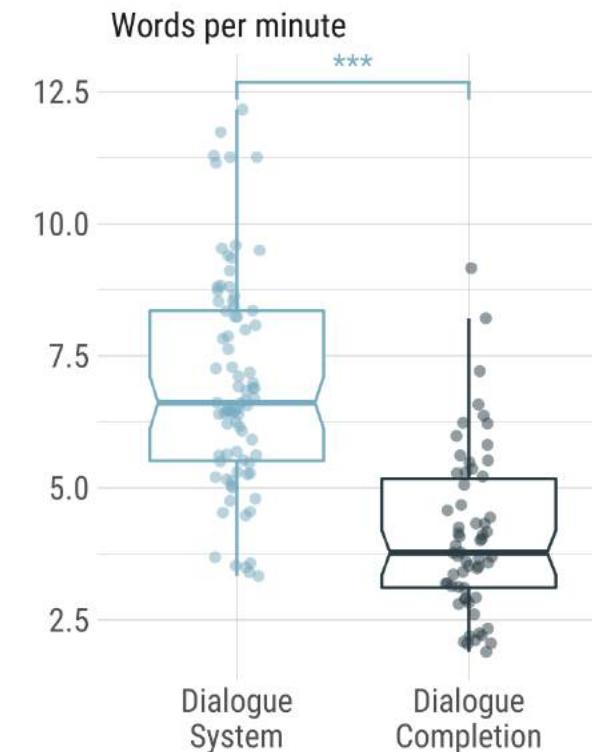
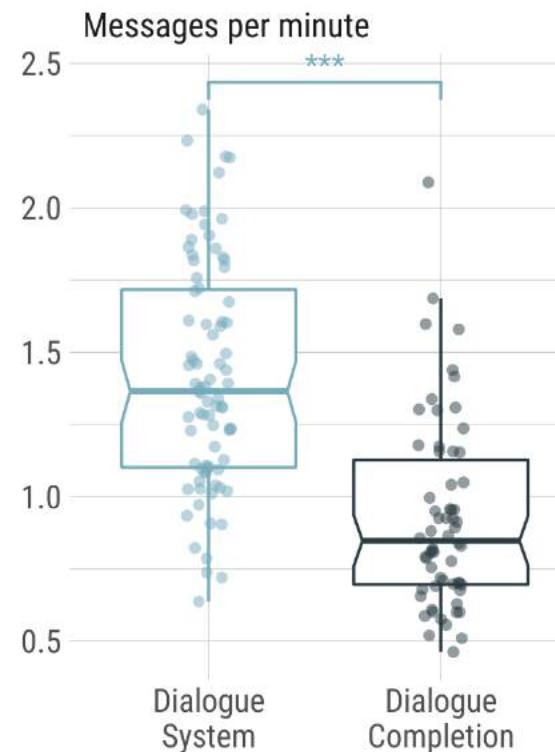
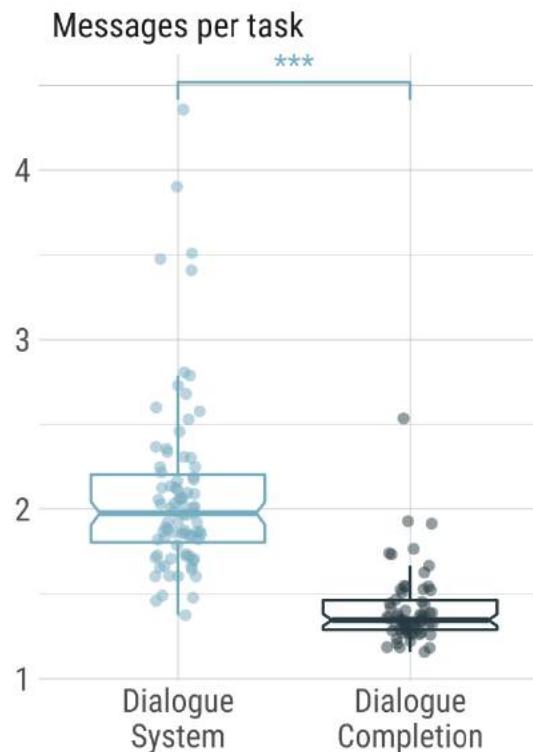
# Resultados experimentales: percepciones

- Sin diferencias en la percepción de interactividad, utilidad, facilidad de uso... 😱



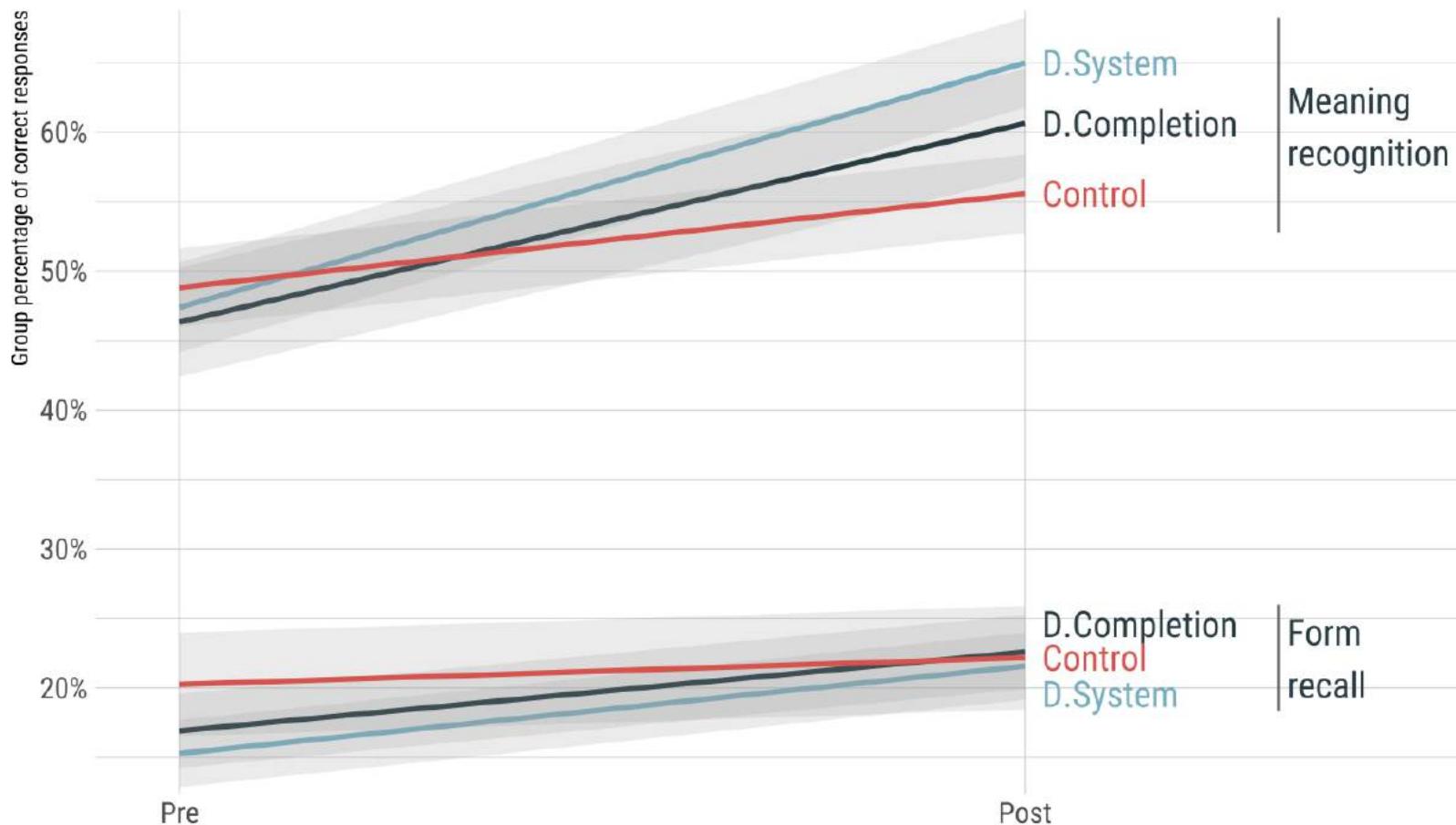
# Resultados experimentales: participación

- Aumento muy claro de la participación conductual (cantidad, intensidad, velocidad).
- Sistema de diálogo: frases más largas, más rápidas, atención al significado.  
Compleción de diálogo: frases más cortas y densas, más lentas, atención a la forma.



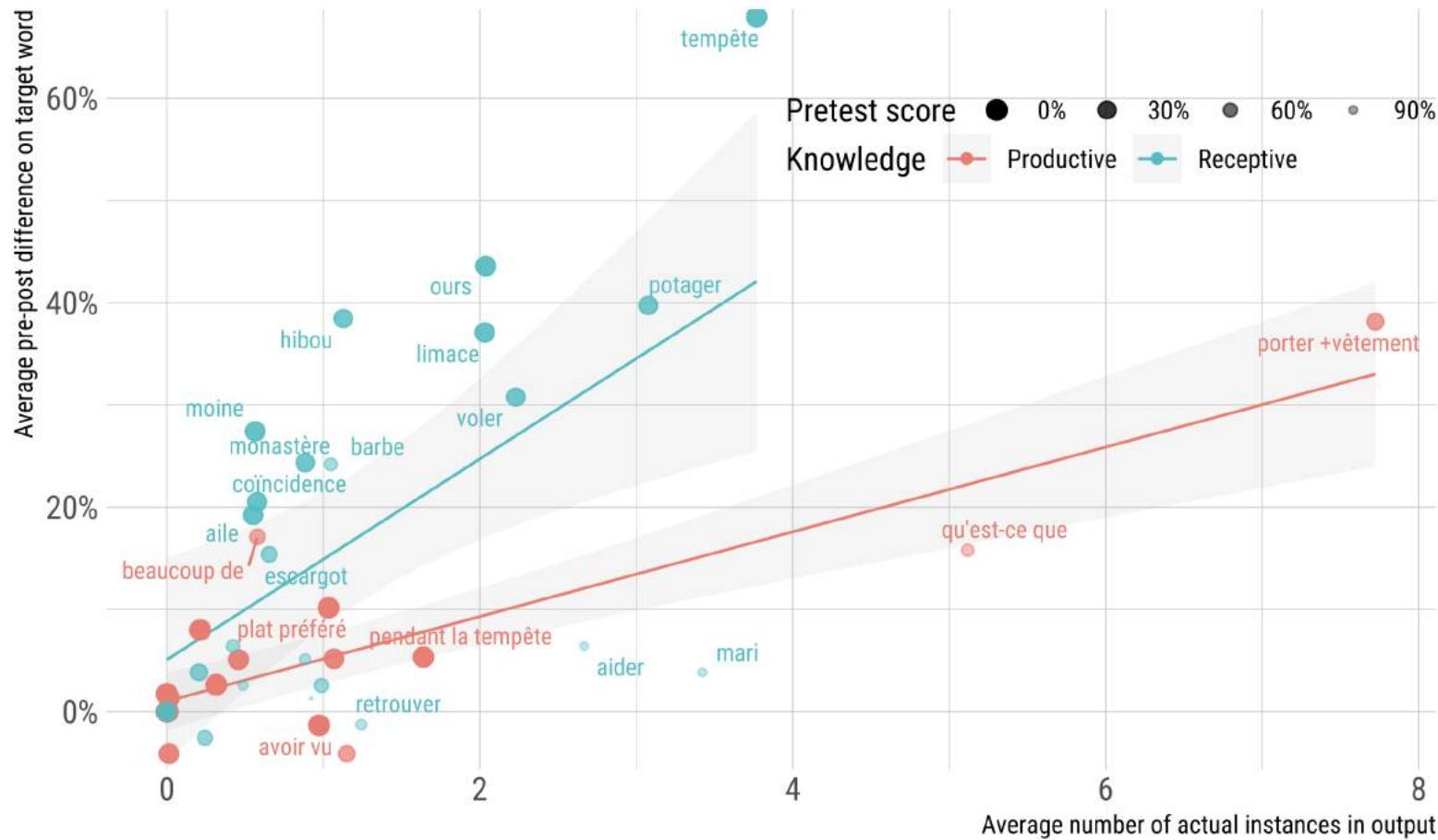
# Resultados experimentales: vocabulario

- Efectos similares en el vocabulario receptivo y productivo.



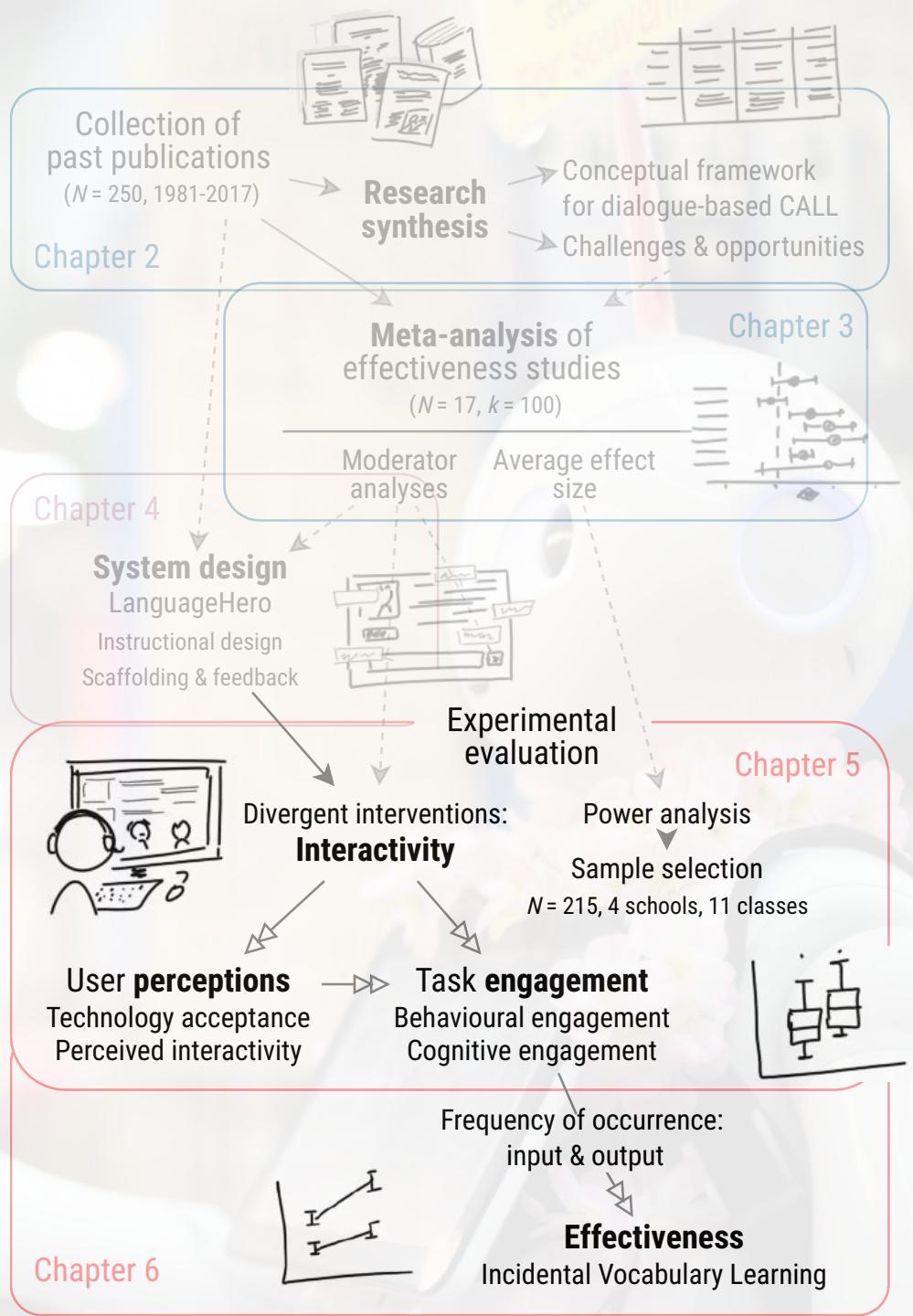
# Resultados experimentales: frecuencia de exposición

- Sistema de diálogo: más exposición productiva ( $\times 2$ )  $\Rightarrow$  Aprendizaje productivo reforzado.



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5. Limitaciones y perspectivas

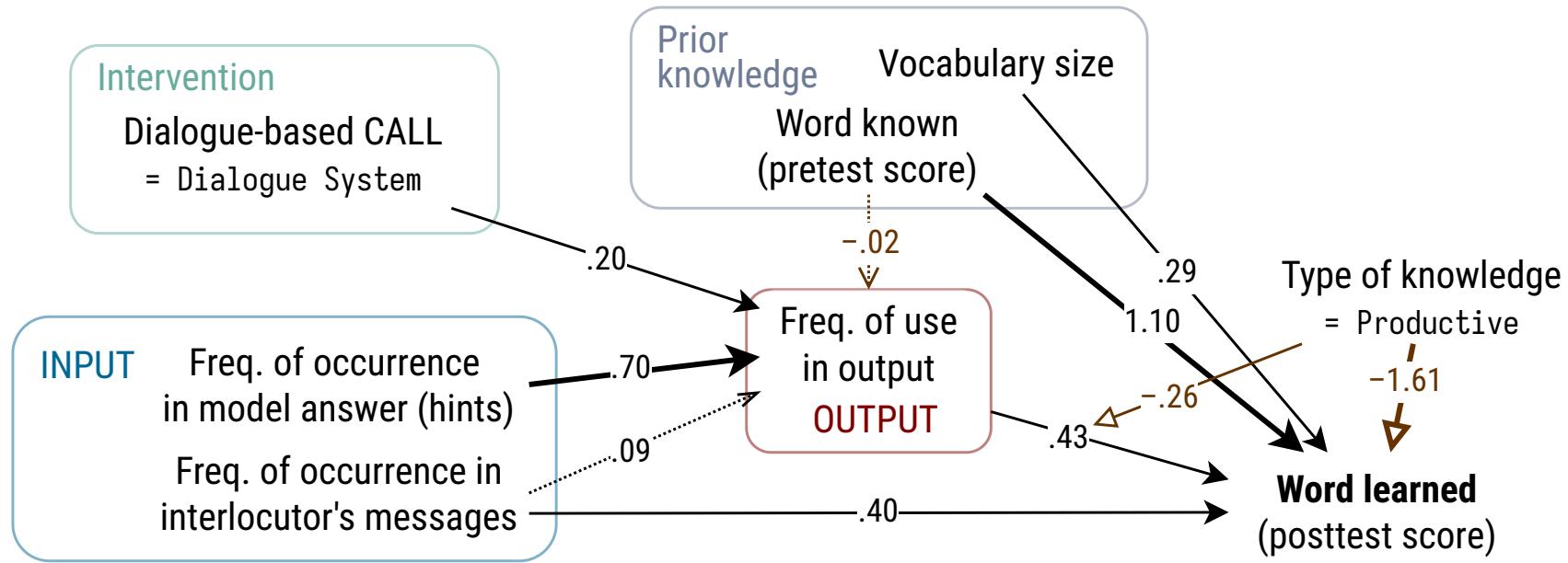


# ¿Qué papel para la interactividad?

- Percepciones y aprendizaje más afectados por la **interactividad instructiva** (retroalimentación, andamiaje) que por la agencia del usuario en el diálogo.
  - Interactividad como **negociación de la forma y el significado**: reintentos, autorreparación... (*negotiation of meaning + form*)
  - ⇒ Para un CALL conversacional efectivo:
    - ↑ **retroalimentación, andamiaje, adaptabilidad**
    - ↓ capacidad de procesar cualquier cosa.
- Interfaz interactiva/dinámica ⇒ **Participación**
  - Más enfoque en la fluidez y el significado
  - Más *output* ⇒ Uso más productivo del vocabulario ⇒ Aprendizaje reforzado

# ¿Qué papel para el output?

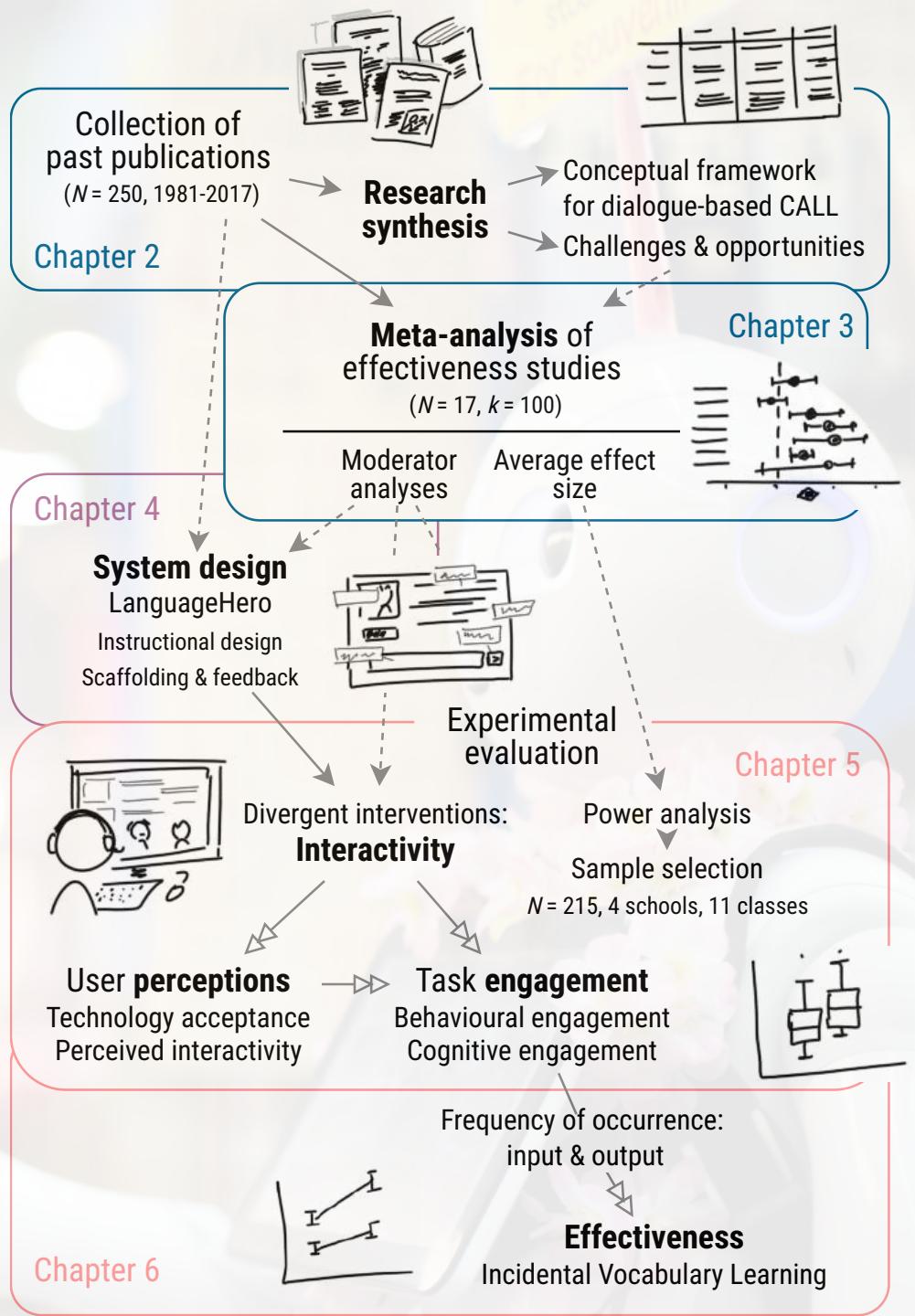
- Modelo de aprendizaje de vocabulario productivo incidental



- La exposición productiva es complementaria a la receptiva.
- Confirma la necesidad de la práctica productiva para el conocimiento productivo.  
(e.g., Yanagisawa & Webb, 2021)

# IA y aprendizaje de idiomas

1. Estado de la cuestión
2. Marco conceptual
3. Efectividad
4. Interactividad y output
5. Limitaciones y perspectivas



# Limitaciones

- **Sistema:** diseño que daba prioridad a la historia
  - → instrucciones explícitas de microtareas
  - → control reducido del usuario
  - → diferencia limitada entre las condiciones
- **Experimento:** necesidad de intervenciones más largas y adaptativas/adaptadas.
- **Instrumentos:** errores menores y dificultad excesiva de la prueba de vocabulario.
- **Epistemológico:** esencialmente cuantitativo, posibles omisiones.



# Perspectivas

- IA conversacional para el **aprendizaje autónomo de idiomas**:
  - necesita sistemas públicos, colaboraciones con la industria  
(Sydorenko, 2019)
  - desarrollo centrado en andamiaje, adaptabilidad, feedback
- IA conversacional para **investigación y pruebas**:  
(Ziegler et al., 2017; Meurers et al, 2019; Timpe-Laughlin et al., 2022)
  - **Interacciones monitorizadas y diseñables**
- IA conversacional como **nueva realidad** en interfaces persona-ordenador



# ¡Muchas gracias!

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