UNIVERSITY OF WESTERN MACEDONIA
School of Social Sciences and Humanities
Department of Primary Education

Exploring Pre-Service Teachers' Perceptions on Inclusive Inquiry-Based Science Teaching and Learning

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TOGETHER WE ARE BETTER
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PURPOSE OF THE STUDY

Investigating the perceptions of pre-service teachers who participated in a course on inclusive science teaching regarding inclusive inquiry-based teaching and learning in Science Education

1. how they perceive and relate to inclusive inquiry-based teaching and learning in Science Education
2. what attitudes they hold towards these practices (pedagogical, value-based, and practical)
3. how they position themselves as pre-service teachers in Science Education

Theoretical Framework

Inquiry-Based Science Education

Inclusive Education

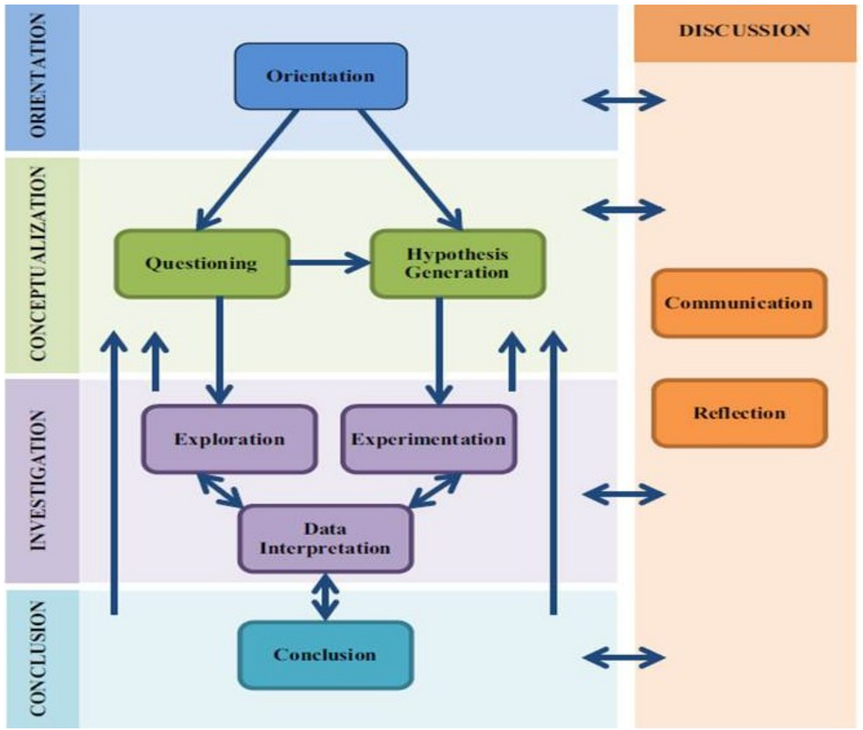
Theoretical Framework

Inquiry-Based Science Education

- development of critical thinking skills
- formulation of questions
- use of scientific practices
- achievement of learning outcomes

(Crawford, 2014; Pedaste et al., 2015)

Model of Pedaste et al. (2015)



Theoretical Framework

Inquiry-Based Science Education

Developing these skills during initial teacher education is essential, so that they can confidently apply inquiry-based teaching in Science Education

Teachers' Perceptions of Inquiry-Based Teaching

They express a positive attitude and intention to incorporate inquiry-based teaching into their future teaching practice
(Achurra et al., 2014)

Their participation in inquiry-based learning experiences during their education strengthens both their attitude and their self-efficacy to teach using inquiry-based methods
(Strat et al., 2024)

Theoretical Framework

Inquiry-Based Science Education

«Science for All»

concept of providing equal and inclusive access to science education and opportunities for individuals of all backgrounds and abilities, regardless of race, gender, socioeconomic status, or any other factor that may create barriers in teaching and has been highlighted in reform documents for several decades

(American Association for the Advancement of Science (AAAS), 1989; National Research Council, 1996)

Theoretical Framework

Inclusive Education

«is the process of providing education to all children irrespective of individual differences or abilities; aims to include all students in a classroom as active participants in learning, and the process of inclusion is beneficial to all involved»

(Boyle et al., 2022, p. 43)

Theoretical Framework

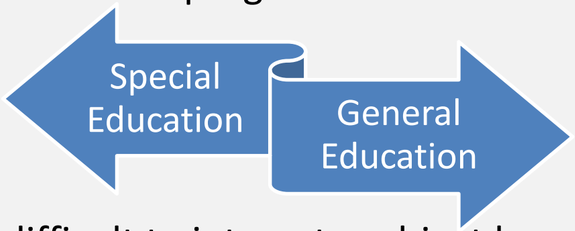
Inclusive education is often treated as an additional component (add-on) rather than as an integrated pedagogical dimension, which limits its connection with Science teaching (Fränkel et al., 2023)

Teacher Education in Inclusive Science Education

Initial teacher education in Science still lacks a coherent framework for Inclusive Education

(Fränkel et al., 2023)

The separation between teacher education programs



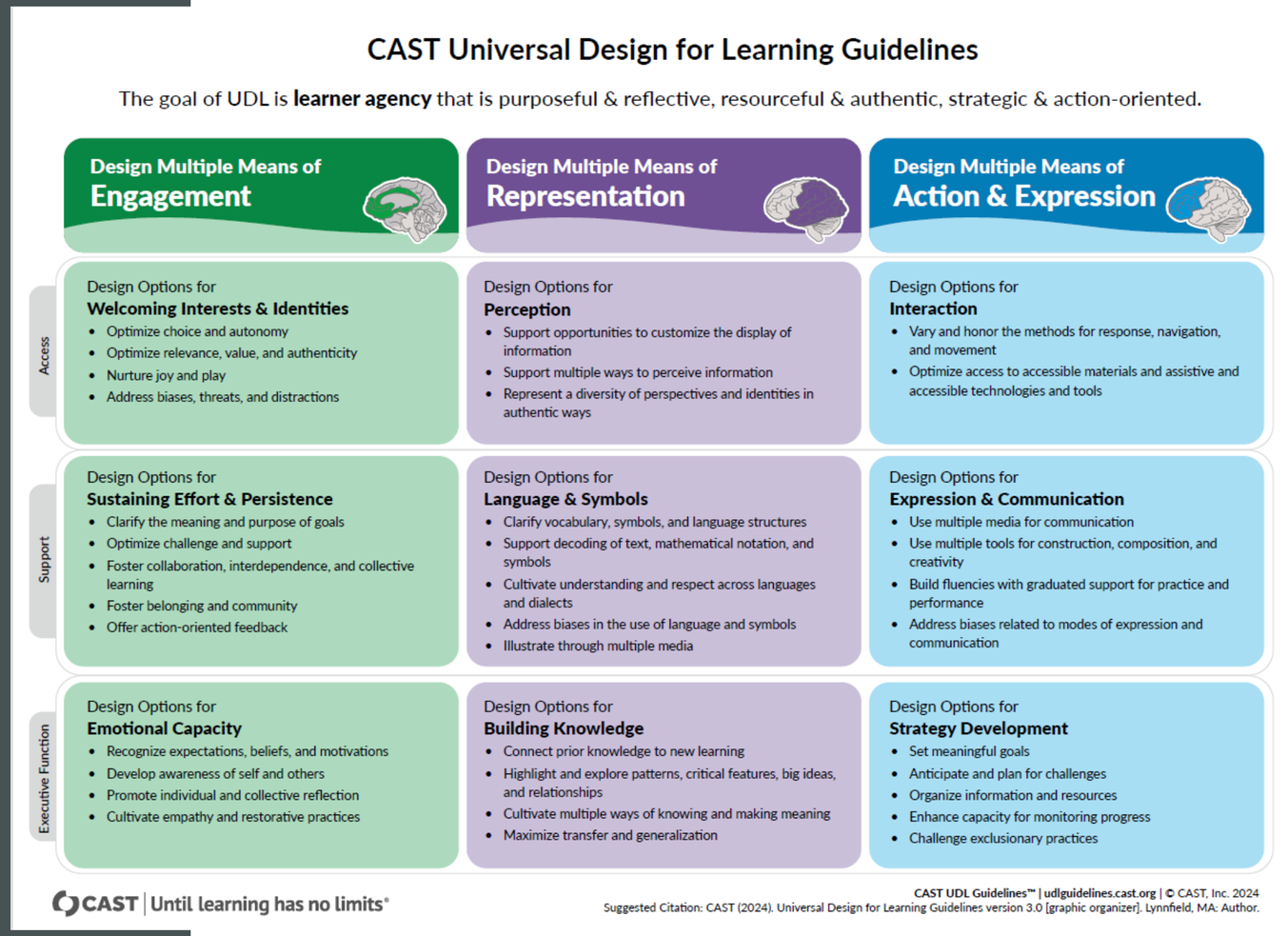
makes it difficult to integrate subject knowledge with inclusive content
(Florian & Rouse, 2009)

Teachers' Perceptions of Inclusive Education

As a result, both pre-service teachers and in-service teachers do not feel sufficiently prepared for the implementation of Inclusive Education in Science Education

Traditional perceptions still dominate, focusing on ability and differences
(Essex et al., 2021)

Universal Design for Learning– UDL

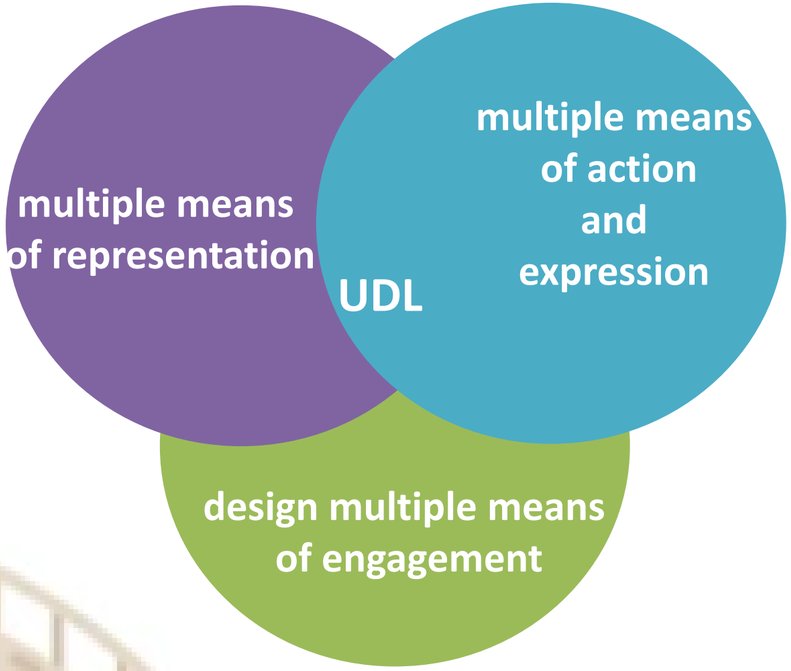


CAST Universal Design for Learning Guidelines

The goal of UDL is **learner agency** that is purposeful & reflective, resourceful & authentic, strategic & action-oriented.

	Design Multiple Means of Engagement	Design Multiple Means of Representation	Design Multiple Means of Action & Expression
Access	Design Options for **Welcoming Interests & Identities** • Optimize choice and autonomy • Optimize relevance, value, and authenticity • Nurture joy and play • Address biases, threats, and distractions	Design Options for **Perception** • Support opportunities to customize the display of information • Support multiple ways to perceive information • Represent a diversity of perspectives and identities in authentic ways	Design Options for **Interaction** • Vary and honor the methods for response, navigation, and movement • Optimize access to accessible materials and assistive and accessible technologies and tools
Support	Design Options for **Sustaining Effort & Persistence** • Clarify the meaning and purpose of goals • Optimize challenge and support • Foster collaboration, interdependence, and collective learning • Foster belonging and community • Offer action-oriented feedback	Design Options for **Language & Symbols** • Clarify vocabulary, symbols, and language structures • Support decoding of text, mathematical notation, and symbols • Cultivate understanding and respect across languages and dialects • Address biases in the use of language and symbols • Illustrate through multiple media	Design Options for **Expression & Communication** • Use multiple media for communication • Use multiple tools for construction, composition, and creativity • Build fluencies with graduated support for practice and performance • Address biases related to modes of expression and communication
Executive Function	Design Options for **Emotional Capacity** • Recognize expectations, beliefs, and motivations • Develop awareness of self and others • Promote individual and collective reflection • Cultivate empathy and restorative practices	Design Options for **Building Knowledge** • Connect prior knowledge to new learning • Highlight and explore patterns, critical features, big ideas, and relationships • Cultivate multiple ways of knowing and making meaning • Maximize transfer and generalization	Design Options for **Strategy Development** • Set meaningful goals • Anticipate and plan for challenges • Organize information and resources • Enhance capacity for monitoring progress • Challenge exclusionary practices

CAST | Until learning has no limits®



Inclusive Education

(CAST, 2024)

Methodology

Research Questions

RQ1: What are pre-service teachers' perceptions of inclusive inquiry-based science teaching?

RQ2: What difficulties, challenges, and support needs do pre-service teachers perceive regarding the implementation of inclusive inquiry-based teaching in Science?

RQ3: What are pre-service teachers' attitudes, intentions, and motivations toward adopting inclusive inquiry-based teaching in Science?

RQ4: How do pre-service teachers perceive the relationship between inclusive and inquiry-based science teaching?

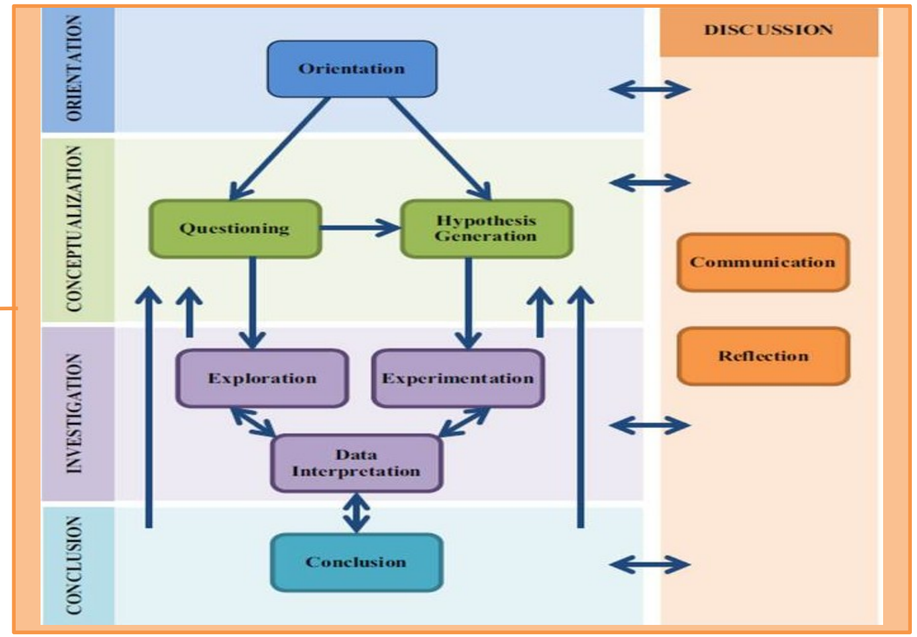
Course Framework

«Physics education course»

- B’ Phase of Teaching Practice
- Department of Primary Education

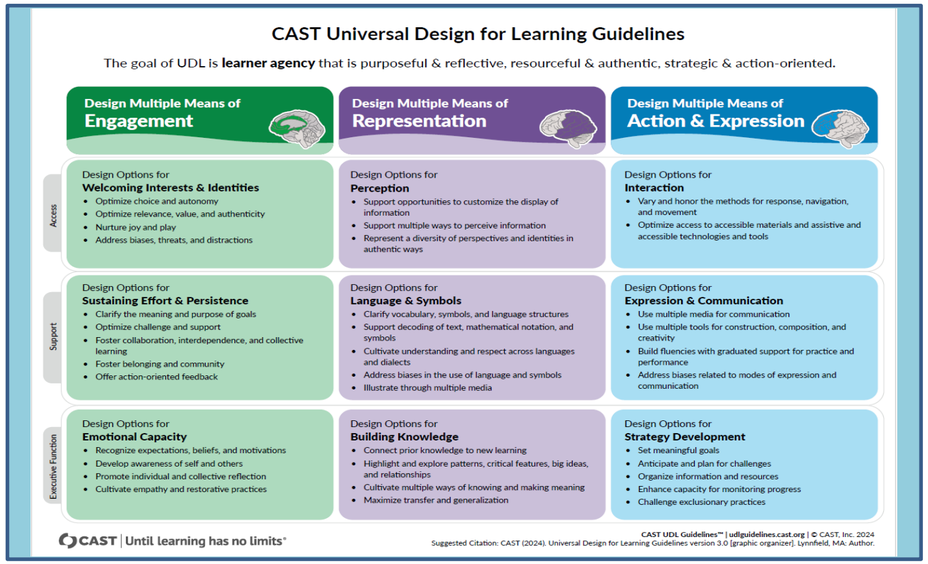
Inquiry-Based Science Education & Constructivism

Pedaste et al. (2015) model



Inclusive Education

Principles of UDL (CAST, 2024)



Course Framework

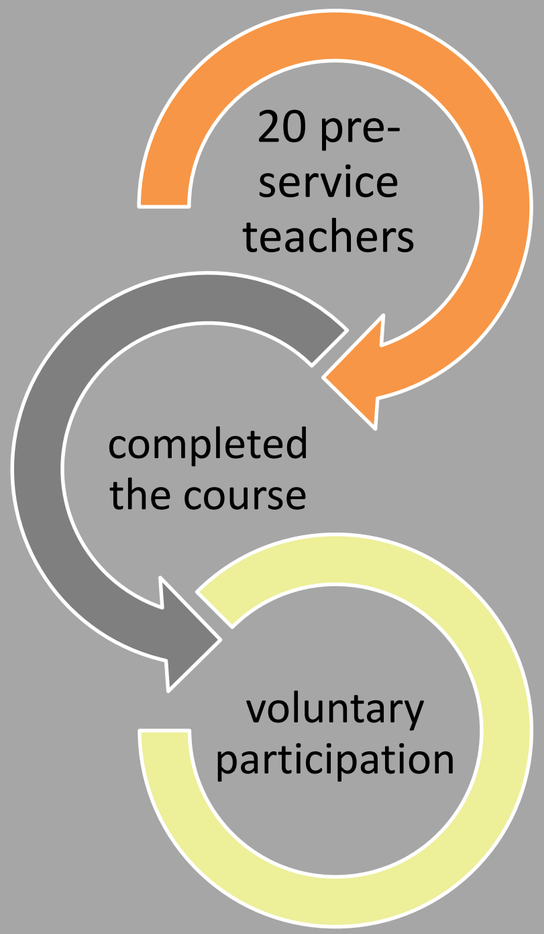
Theoretical Part

- Familiarization with the design of inquiry-based activities
- Development of sequences of inquiry-based activities
- Redesign based on UDL principles
- Reflective discussions at all stages of the theoretical part

Practical Part

- Design and implementation of inclusive inquiry-based teaching
  (duration: 1 teaching hour) in the classroom
- Reflection on the practical part
  – presentation and discussion of the intervention
  – justification of why the design and teaching are inquiry-based and inclusive

Participants



Research Instrument

Semi-structured interview → **Duration: 1 hour** → **Interview protocol**

- Perceptions of Inquiry-Based Teaching (what it is, what it means, how they perceive it)
- Perceptions of Inclusive Teaching and UDL (what it is, what it means, who benefits)
- Perceived difficulties, obstacles, and support needs (knowledge, experience, teaching practice)
- Attitudes, intentions, and motivations for future implementation

Reflexive Thematic Analysis – RTA

The process was iterative and interpretative.

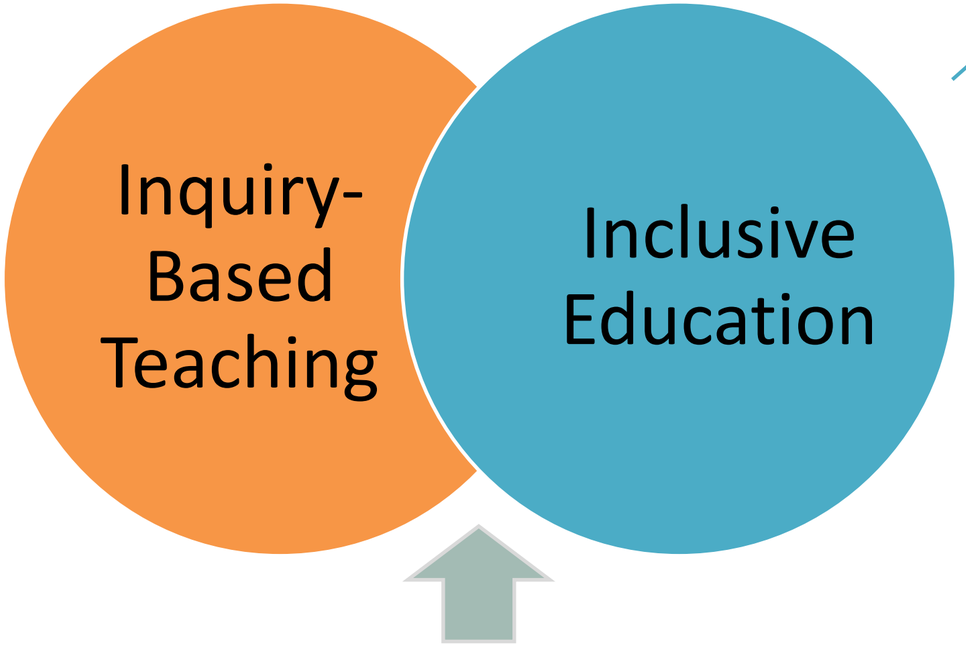
The first researcher conducted the initial coding, while the second researcher as a critical friend contributed through reflective discussions that supported the interpretative development of the themes

RQ1: What are pre-service teachers' perceptions of inclusive inquiry-based science teaching?

Not just a method but…

- **a structured pedagogical process**
- it is not limited to an "active method" or simple experimentation
- **phases, design, and guidance**

(Crawford, 2014; Pedaste et al., 2015)



Not support for some students but…

- Shift from individual-centered **to social and relational approaches**
- Emphasis on the participation of all and the removal of learning barriers
- **Responsibility shifts from the individual to the learning environment**
- Inclusion is also highlighted **as an issue of instructional design**
- Adaptations, multiple ways of participation, and accessibility through design

(Florian, 2019; Morton, 2012; Oliver, 1996)
(CAST, 2024; Meyer et al., 2014)

- Inclusion and inquiry **are not constructed as separate practices**
- They are highlighted as **interconnected dimensions of a shared pedagogical framework**

(Sofianidis & Stylianidou, 2025; Fränkel et al., 2023; Stinken-Rösner et al., 2020)

RQ2: What difficulties, challenges, and support needs do pre-service teachers perceive regarding the implementation of inclusive inquiry-based teaching in Science?

The difficulties identified

- are not limited to individual obstacles
- They are connected to **structural, institutional, and pedagogical barriers**
- These barriers hinder the implementation of inquiry-based and inclusive teaching
- They are not interpreted simply as a lack of knowledge or skills
- They reflect the **complex nature of teaching practice**
- The combination of inquiry-based and inclusive teaching **increases pedagogical demands**

(Fränkel et al., 2023; Spektor-Levy & Yifrach, 2019)

The support needs identified

- are **directly linked to initial teacher education**
- Theoretical input alone is not sufficient **without systematic and practice-oriented preparation**
- Opportunities **for design, implementation, and reflection are required**

(Essex et al., 2021; Fränkel et al., 2023; Sofianidis & Stylianidou, 2025)

Insecurity and a low sense of readiness

- are interpreted through perceived preparedness and self-efficacy
- **Limited practical experience reduces the sense of capability** to implement complex teaching approaches

(Achurra et al., 2024; Tangen & Beutel, 2017; Wray et al., 2017)

The difficulties identified can be understood as challenges of transition from:

Theoretical understanding → Teaching practice

This indicates that the issue is not merely one of attitudes or intentions, but of emerging professional knowledge (Pedagogical Content Knowledge)

(Essex et al., 2021; Fränkel et al., 2023; Sofianidis & Stylianidou, 2025)

RQ3: What are the attitudes, intentions, and motivations toward adopting inclusive inquiry-based teaching in future teaching practice?

POSITIVE ATTITUDES

- coexist with the recognition of the need for better preparation and support

(Boyle et al., 2022; Essex et al., 2021; Kraska & Boyle, 2014; Tangen & Beutel, 2017)

- They are not one-dimensional, but appear to combine value-based, pedagogical, and professional dimensions:
  - The importance of inclusion as an educational principle is recognized
  - The intention to implement it through specific teaching practices is highlighted
  - Students position themselves as future professionals who assume relevant responsibility

INTENTIONS FOR IMPLEMENTATION

- Not presented **as general or naïve**
- Accompanied by awareness of the difficulties and constraints of practical application
  - This can be interpreted as an indication of a more mature **professional positioning** rather than a contradiction

MOTIVATIONS

- Interpreted through the concept of **teacher agency**
- Students are not positioned as passive recipients of knowledge
- They are highlighted as active future professionals who develop their stance and orientation (Priestley et al., 2013)

POSITIVE ATTITUDES & INTENTIONS FOR IMPLEMENTATION

- are connected to the university learning context
- This context appears to have functioned as a catalyst for shaping perceptions
- The critical role of initial teacher education in shaping attitudes and professional orientation is highlighted

(Boyle et al., 2022; Fränkel et al., 2023; Sofianidis & Stylianidou, 2025)

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  - The i… educ…
  - The i… speci…
  - Stude… profe… responsibility

INTENTIONS FOR IMPLEMENTATION

- Not presented **as general or naïve**
- Accompanied by awareness of the difficulties and constraints of practical application
  - This can be interpreted as an indication of a more mature **professional positioning** rather than a contradiction

The study does not focus only on positive attitudes
It highlights **their connection with emerging professional agency**
It sheds light on how participants **perceive their role as future teachers**
It contributes to understanding the formation of professional identity

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…ON

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(Boyle et al., 2022; Fränkel et al., 2023; Sofianidis & Stylianidou, 2025)

RQ4: How do they perceive the relationship between inclusive and inquiry-based teaching in Science?

Inquiry

- Not understood only as an epistemologically “correct” method
- Also highlighted as a means of promoting access and participation
- Supports the active engagement of all students in the learning process

(Crawford, 2014; Stinken-Rösner et al., 2020; White & Frederiksen, 1998)

Inclusion

- **Not presented as an additional element within inquiry-based teaching**
- Highlighted as a quality criterion of inquiry itself
- Determines the extent to which inquiry is meaningfully accessible to all students

(Fränkel et al., 2023; Stinken-Rösner et al., 2020)

Relationship between inquiry-based and inclusive teaching

- UDL functions as a bridge between inclusive and inquiry-based teaching
- It translates participation into specific design strategies

(CAST, 2024; Meyer et al., 2014)

- Inclusion is embedded in the way content is organized and taught
- Designing “inclusive inquiry” is highlighted as a matter of specialized professional knowledge

(Carlson et al., 2019; Gess-Newsome, 2015; Kind, 2009; Shulman, 1986)

Overall, the study supports a unified perspective of “inclusive inquiry-based teaching,” where inquiry and inclusion are not treated as two separate or additive pedagogical fields, but as interconnected and mutually constitutive dimensions of a shared instructional framework.

(Fränkel et al., 2023; Sofianidis & Stylianidou, 2025; Stinken-Rösner et al., 2020)

Theoretical, pedagogical, and research implications

INITIAL TEACHER EDUCATION

- **Integrate Inclusion & Inquiry**
- **Positive Attitudes Are Not Enough**
- **Professional Identity & Agency**

INSTRUCTIONAL DESIGN IN SCIENCE EDUCATION

Inclusion does not automatically emerge through inquiry; it needs to be an explicit criterion in instructional design.

(Fränkel et al., 2023; Stinken-Rösner et al., 2020)

Inquiry-based teaching requires structure, guidance, and pedagogical organization in order to be truly accessible and not only theoretically open

Theoretical, pedagogical, and research implications

TEACHER SUPPORT AND THE INSTITUTIONAL CONTEXT

1. STRUCTURAL & PEDAGOGICAL CONSTRAINTS

Implementation difficulties are not only individual, but are linked to **structural, organizational, and pedagogical constraints**

(Fränkel et al., 2023; Waitoller & Artiles, 2013)

2. SUPPORT & COLLABORATION MAKE THE DIFFERECNE

The implementation of inclusive inquiry-based teaching requires **frameworks of support**, **collaboration, and reflection**, both at the university and at the school level

(Boyle et al., 2022; Essex et al., 2021)

3. FROM "SCIENCE FOR ALL" TO CONCRETE CHOICES

General declarations such as "**science for all**" need to be connected with more **concrete choices in teacher education and instructional design.**

(Sofianidis et al, 2025)

REGARDING THE THEORETICAL CONTRIBUTION OF THE STUDY

1. The findings support a more unified perspective on the relationship between inclusion and inquiry, rather than a simple parallel coexistence of two fields

   (Sofianidis & Stylianidou, 2025; Stinken-Rösner et al., 2020)

2. UDL can be understood as **a theoretical and design bridge between the values of inclusion and the demands of inquiry-based teaching**

   (CAST, 2024; Meyer et al., 2014)

3. The study highlights not only perceptions, but **also the transition toward emerging professional knowledge for inclusive Science teaching**

   (Carlson et al., 2019; Gess-Newsome, 2015; Priestley et al., 2013)

Conclusions

- Coherent relationship between inquiry-based and inclusive teaching
- Structured understanding of inquiry
- Inclusive design as participation and removal of barriers
- The transition from theory to practice is critical
- Emerging professional knowledge and agency
- Need for systematic integration in initial teacher education

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