

Developing biology teacher's Pedagogical Content Knowledge in evolution: a case study with two experienced teachers

Arlette Bassaber, Claudia Vergara & Hernán Cofré





Introduction

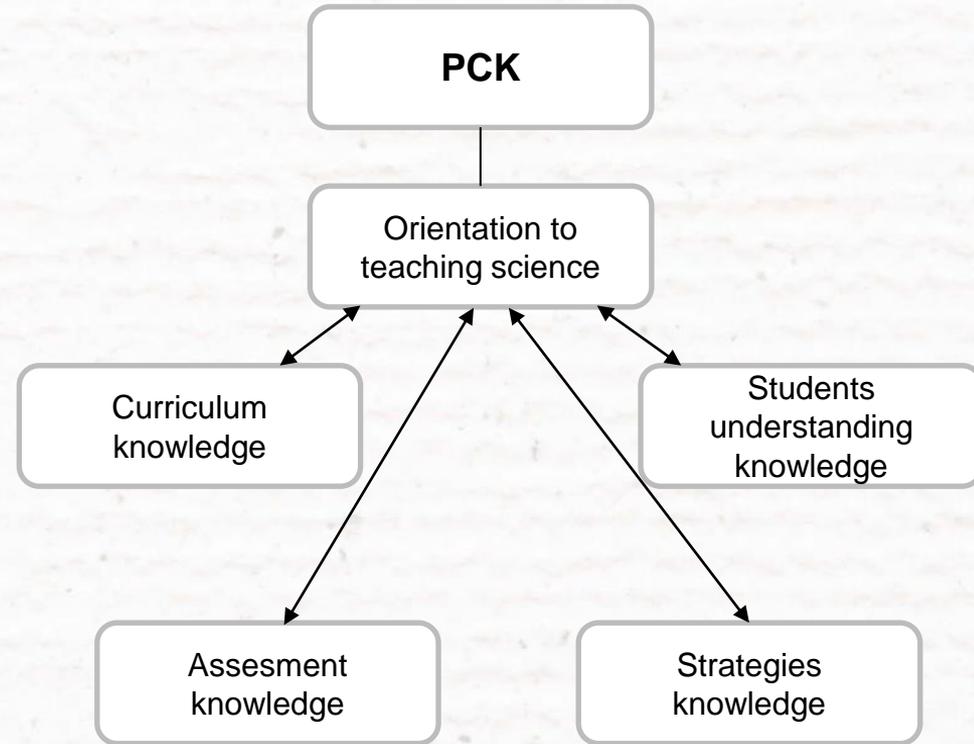
- Pedagogical Content Knowledge (PCK) is a dynamic construct unique to teachers that differentiates a teacher from an expert in a specific topic (Shulman 1986, 1987).
- Learning to teach science is a difficult process, but developing the PCK would be even more complex (van Driel et al., 2014), and only the experience of teaching is not enough to guarantee development or sophistication of this knowledge (Friedrichsen et al., 2009).
- In Chile different studies about PCK has shown weaknesses in the science teachers training (Cofré et al., 2010, 2015).
- In relation to the content evolution and PCK: that has not been deeply investigated in PCK (Bravo & Cofré, 2016).

2

Theoretical Framework

PCK

- The ways to represent and make the topic comprehensible to others (Shulman, 1986).
- Identify PCK as **one of the seven** elemental components to describe the teachers' professional knowledge (Shulman, 1987).
- From Shulman (1987) until now there are different models showing the PCK (Park & Oliver 2008; Gess Newsome, 2015; Carlson & Daehler, 2019)
- This study considering the Magnusson, Krajcik, & Borko (1999) model.



PCK Components for Science Teaching
according to Magnusson's et al. (1999) model

2

Theoretical Framework

Evolution

- There is sufficient evidence showing that many biology teachers around the world have problems both **understanding and accepting** evolution (e.g., Authors., 2017; van Dijk, 2009);
- Therefore, they also have **many problems teaching** this content.

- One of the limitations for biology teachers to correctly teach this content is **their low development of PCKevo** (e.g., Romine et al., 2014; Sickel & Friedrichsen, 2013).
- Glaze and Goldston, (2015) have established that student-centered teaching, which includes active learning, is an effective approach for teaching evolution.

2

Theoretical Framework

Several studies about PCKevo have been done in the last years (e.g., Cofre et al., 2016, 2022; Lucero et al., 2017; Friedrichsen et al., 2018; Sickel & Friedrichsen, 2018; Fischer et al., 2021; Hartelt et al., 2022, see also Sickel & Friedrichsen, 2013). However, most of them have focused in one or two components of Magnusson's model

Lucero et al., (2017) in the United States, revealed that teachers were not making use of preconceptions of their students to direct their teaching.

Hartelt et al., (2022) studied the development of PCKevo in pre-service and in-service biology teacher and found that the ability to diagnose and deal with preconceptions correlated with teachers' content knowledge and acceptance of evolution.

Research question and Method

How two experienced teachers who teach evolution at 9th grade develops her PCK of evolution?

Method

- In 2017 the Chilean national curriculum **changes the content Evolution from grade 11th to 9th**, even when the students have not seen genetics or ecology yet.
- Studies show that **knowledge about genetic and ecology** serves to address evolution more integrated and generate in students' deeper knowledge on topics of evolution, such as natural selection.
- Therefore, this **new context can be especially challenging for teachers.**

Design and Participants

- The research about describing the development of PCK in **two biology teachers** is **qualitative in nature**, with a **case study design** (case 1 and 2).
- The biology teachers were selected with **more than 10 years teaching experience**, and they have not participated in any teaching develop program related with teaching evolution.
- Both teachers have graduate from the same university and in the same year.



Data sources and data Analysis

Declarative PCK

CoRe Pre interview

Analysis using a matrix with pre-existing categories.

- **Knowledge of Science Curricula**
- **Knowledge of Instructional Strategies**
- **Knowledge of Students Understanding of Science**
- **Knowledge of Assessment**

And emerging categories (Flick, 2007).

Methodological
Triangulation

Researchers
Triangulation

Procedural PCK

Videorecording Classes
of evolution (7 lessons
case 1, 5 Lessons case 2)

- Analyzed with an observation rubric adapted from Park et al. (2011), which allows calculating PCK score by lesson and thus determining a PCK development along the unit.

- The rubric considers the 4 components of the PCK model of Magnusson et al. (1999) and specific topics of evolution.
- The rubric was applied by 2 researchers to each of the classes independently and the differences in the coding's were agreed upon and recoded, (Kappa = 0.78).
- This allows to categorize the PCK of the teacher as **basic, skillful, and advanced**.

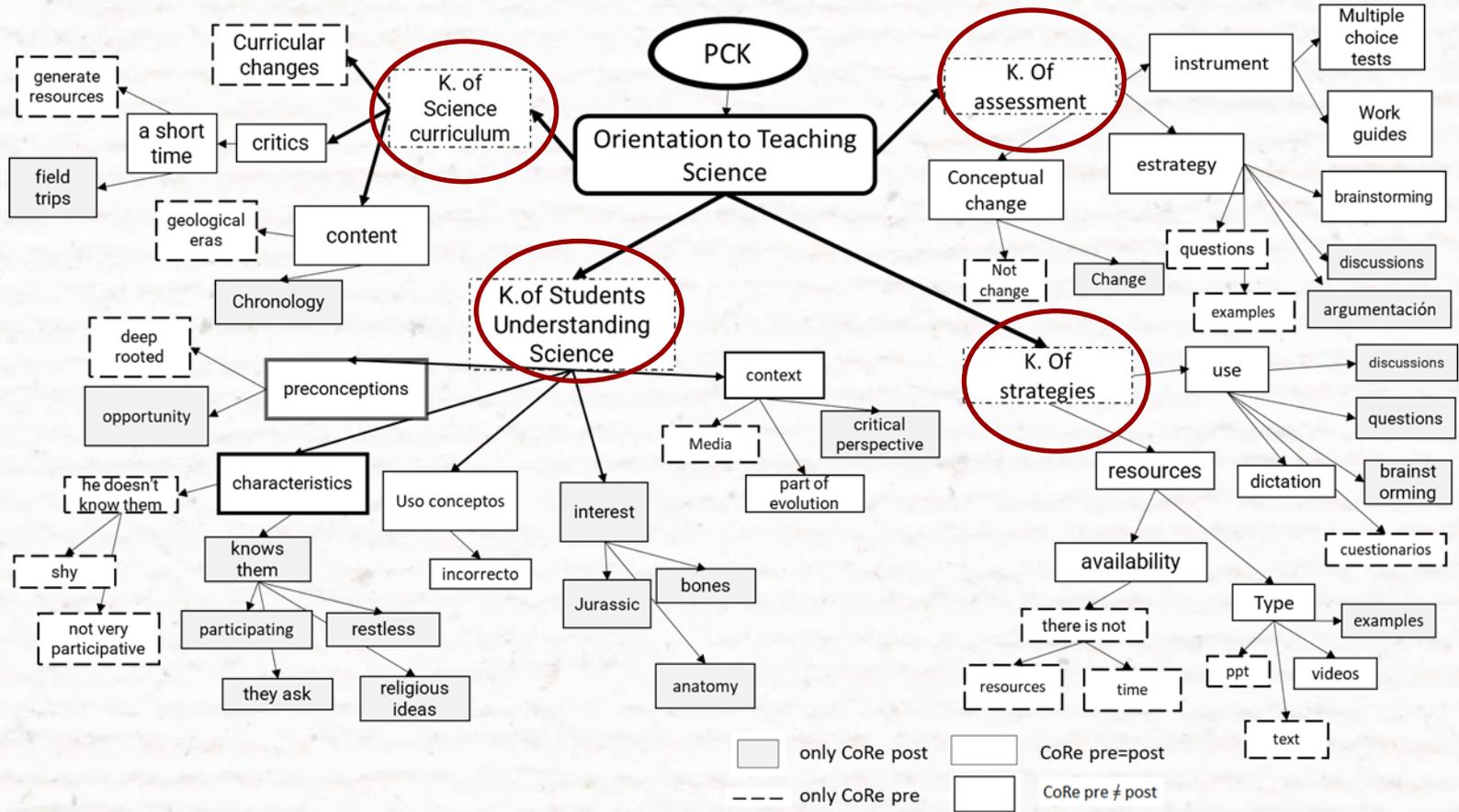
Declarative PCK

CoRe Post interview

Critical Situations (5
situations select for
each teacher)

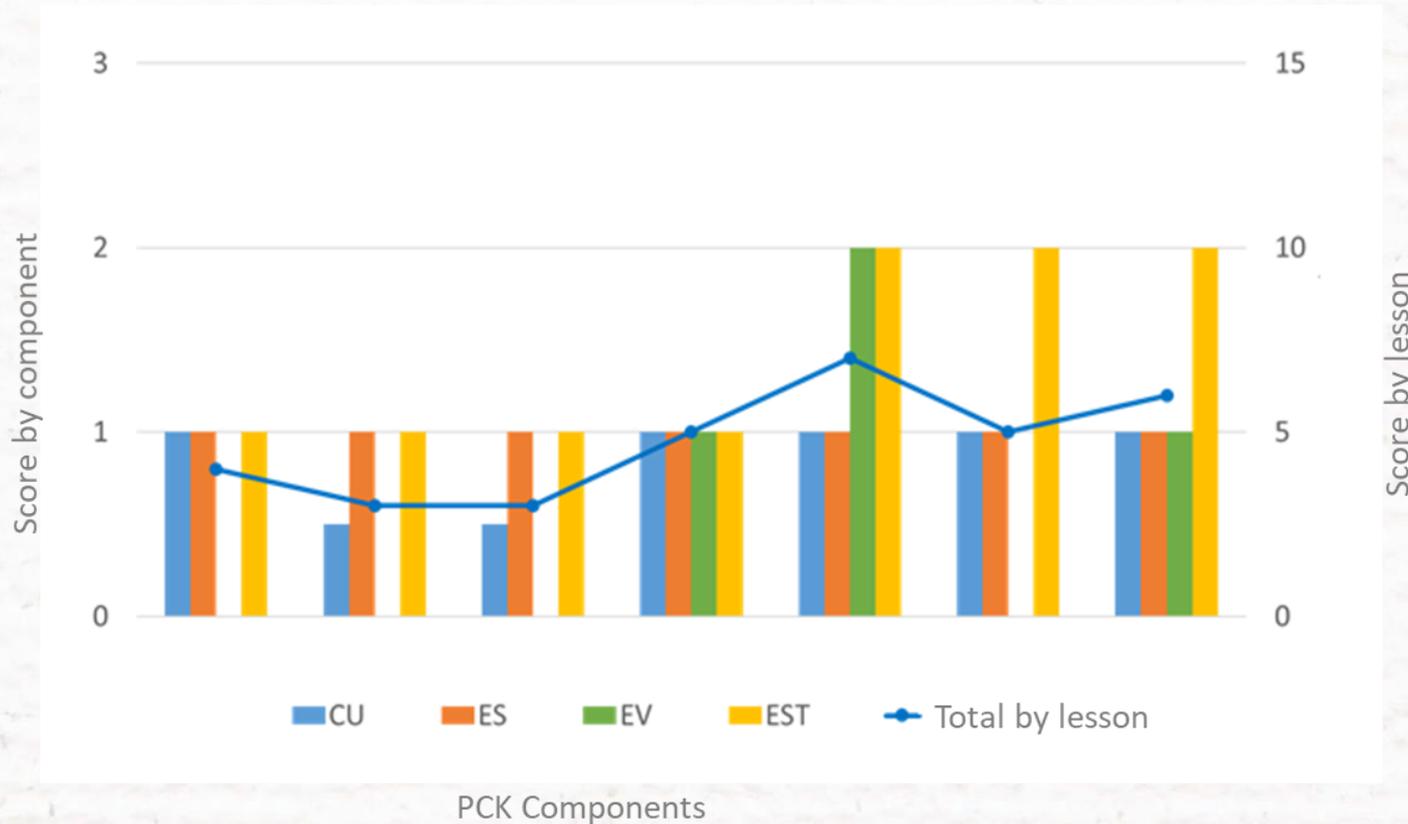
PaP-eRs Interview

Teacher Antonia's Outcomes: CoRe pre - post

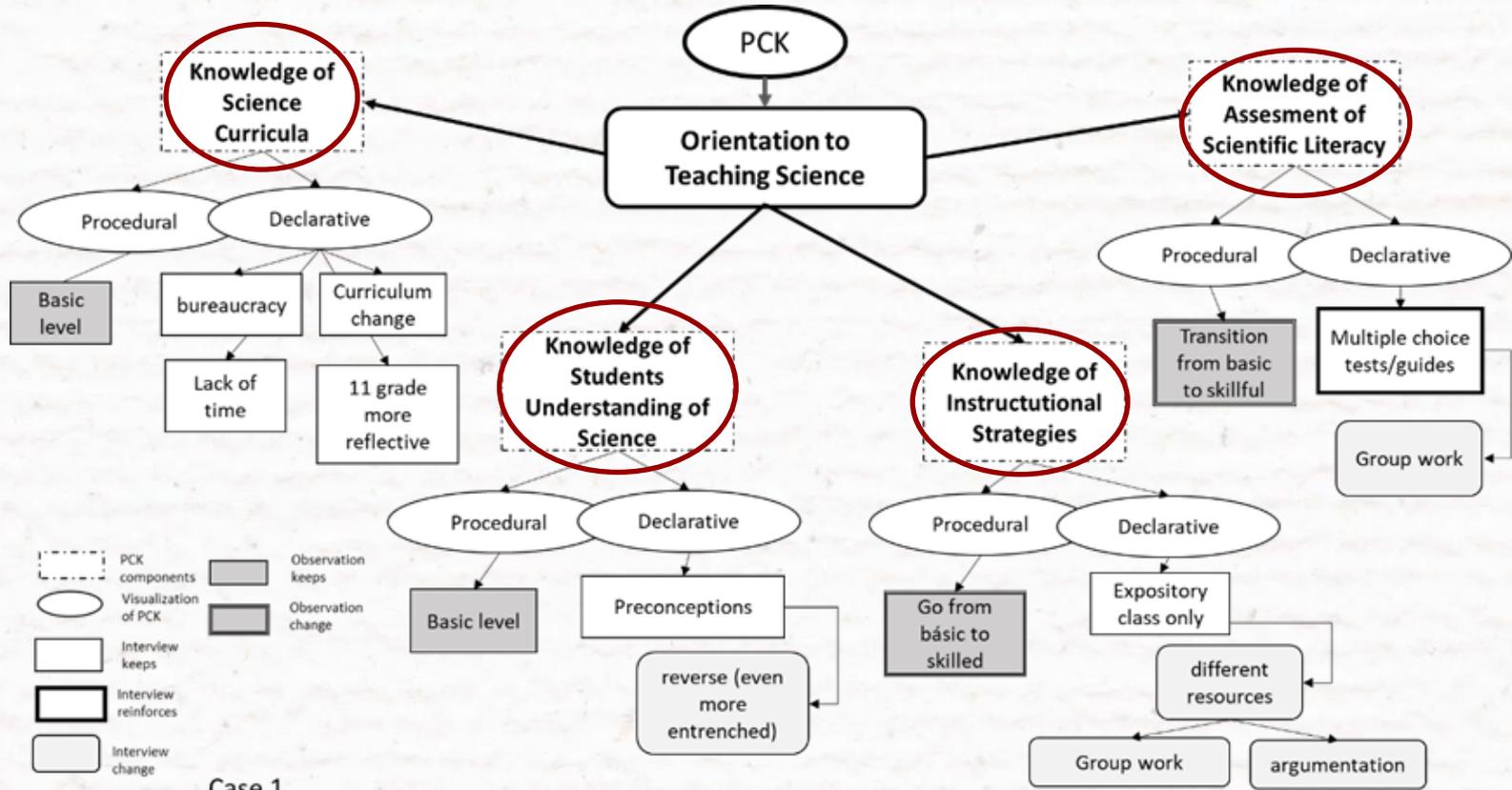


Teacher Antonia's Outcomes: Procedural PCK

Development of procedural PCK Case 1



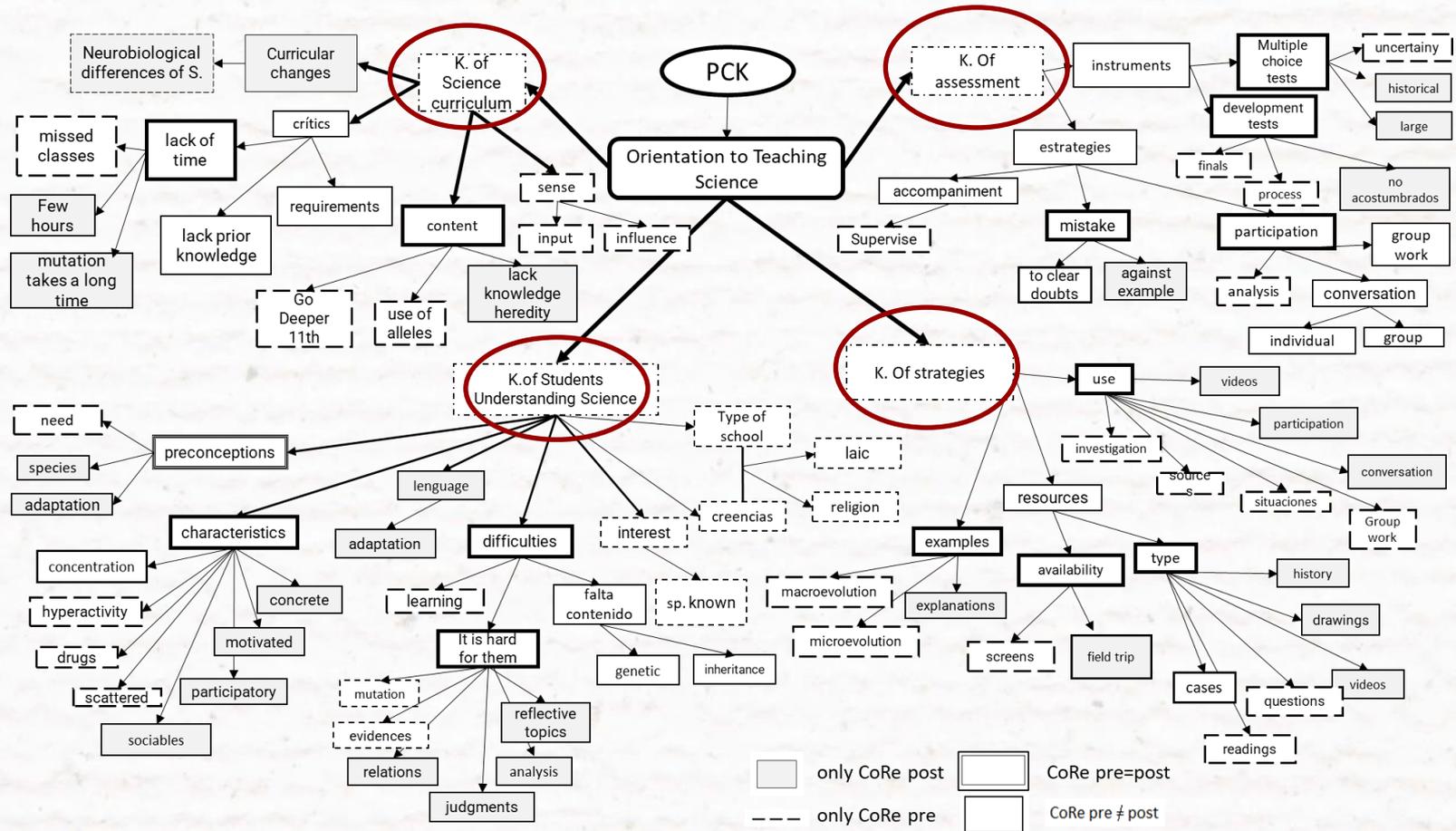
Teacher Antonia's Outcomes: Triangulation



Case 1

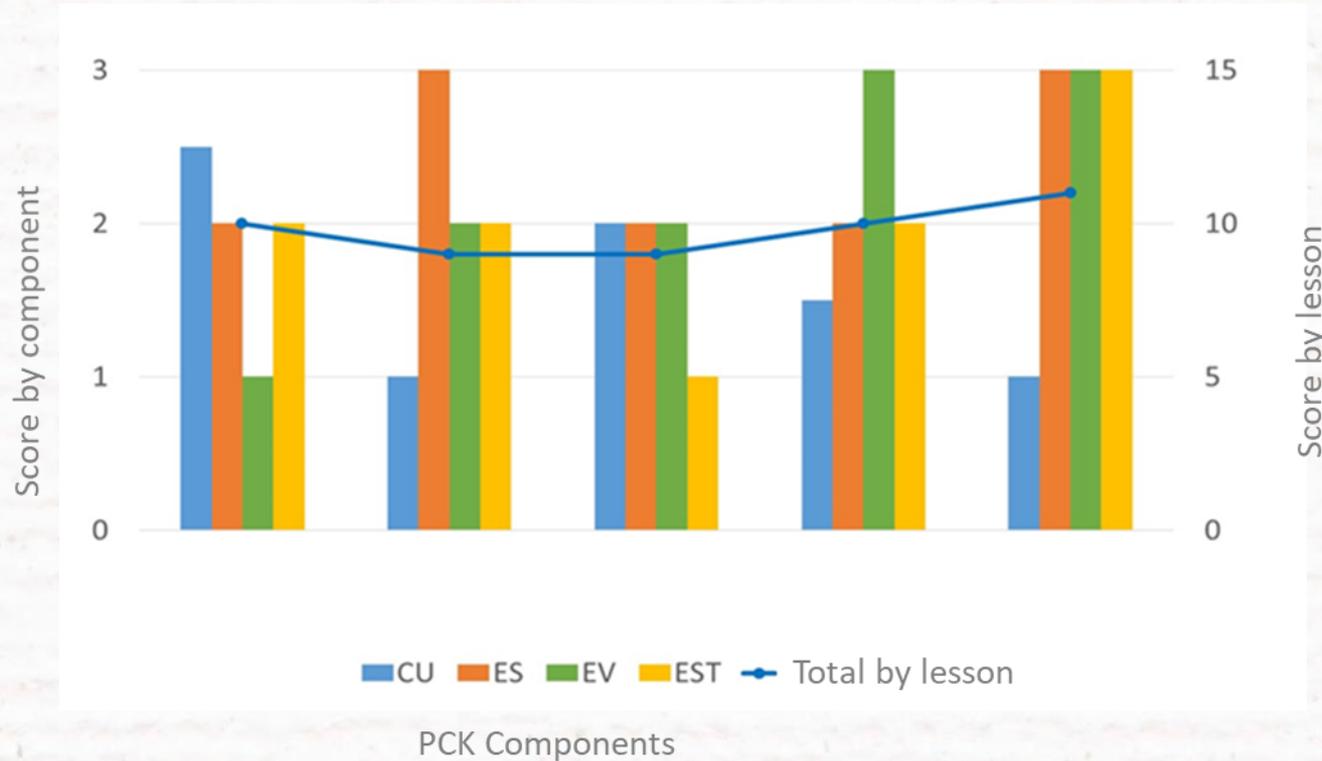
Triangulation among teacher Antonia's outcomes of CoRe pre, CoRe post, evaluation sheet and Pap-Ers.

Teacher Barbara's Outcomes: CoRe pre - post

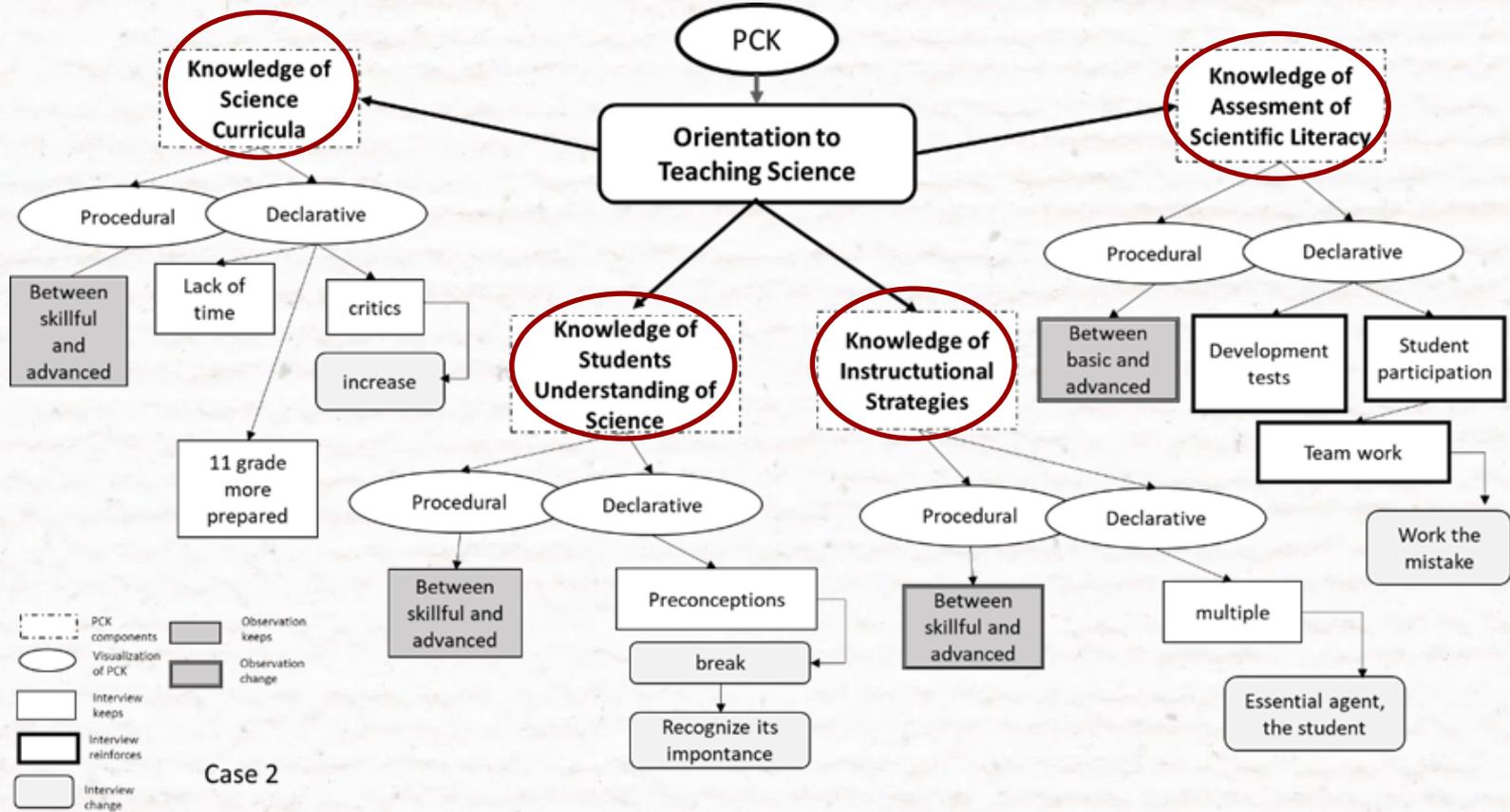


Teacher Barbara's Outcomes: Procedural PCK

Development of procedural PCK Case 2



Teacher Barbara's Outcomes: Triangulation



Triangulation among teacher Barbara's outcomes of CoRe pre, CoRe post, evaluation sheet and Pap-Ers.

5

Conclusion and Discussion

→ The declarative PCK of both teachers is different in terms of the amounts of elements associated with each of the subcomponents, as well as are different the deep levels of knowledge that they have regarding each of the components mentioned.

→ In the declarative PCK of both teachers, it is valued the significance of teaching evolution as part of the national curriculum, which agrees with studies carried out in other countries, in which it is set out that evolution is treated as an unifying organizational principle. (Becerra & Cofré, 2021)

5

Conclusion and Discussion

- ➔ This study is that one of the few studies where the development of the evolution PCK is described including the four components of the Magnusson et al., (1999) model.
- ➔ We can be recognized that the assesment component and the students' knowledge are less developed, which coincides with previous studies (Lucero et al., 2017; Friedrichsen et al., 2018; Fischer et al., 2021; Hartelt et al., 2022).
- ➔ We have also found that the reflective work generated in the interaction between the teachers and the researcher can generate a development of the PCK, independent of the initial state in which it is found.



Thank you very much!

Questions?

