Pedagogical Content Knowledge

Lecture 2 - 06/10/2022

Features about how you learn physics

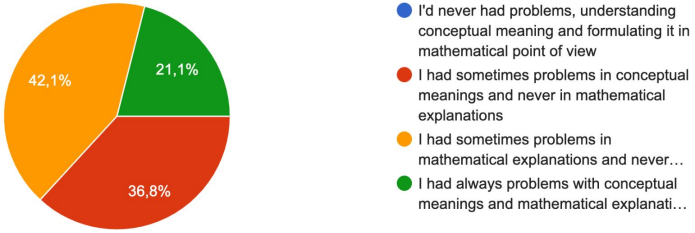
https://forms.gle/i7gPDRJL9Unr3DA46

Which kind of physics learner are you?

19 risposte

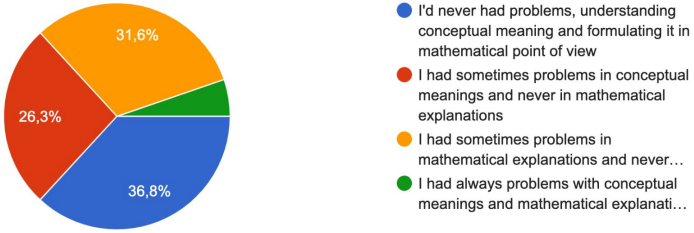
What do you think about the way you learned Physics (in university course)

19 risposte



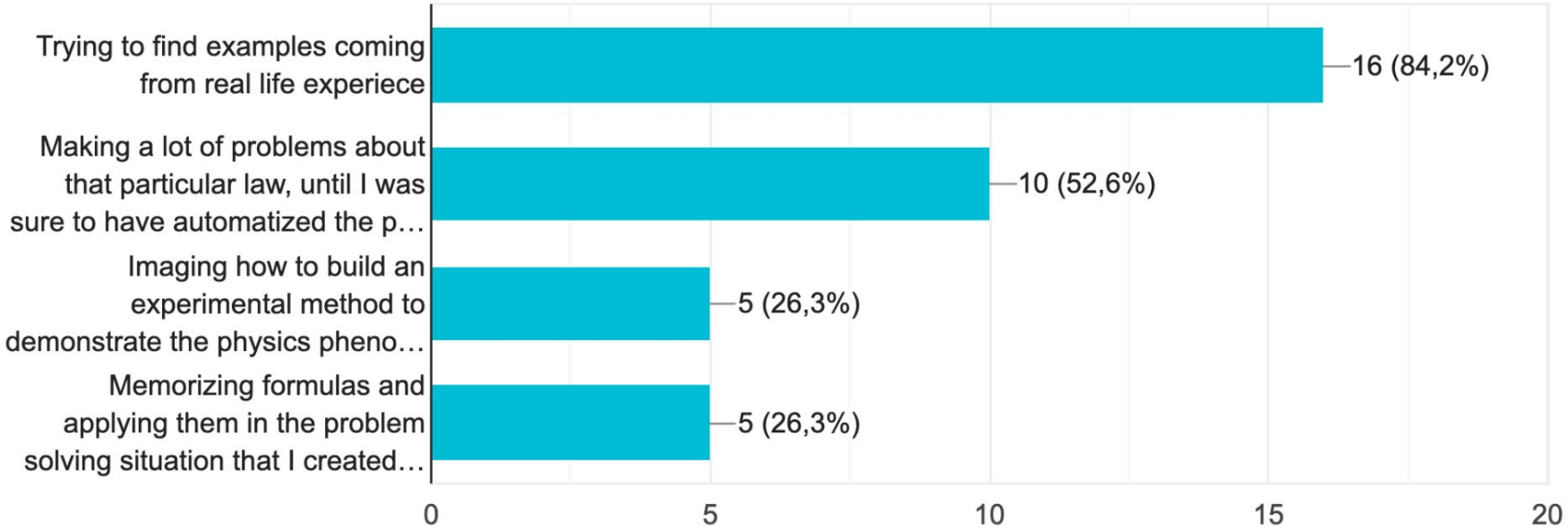
What do you think about the way you learned Physics (in secondary school course)

19 risposte

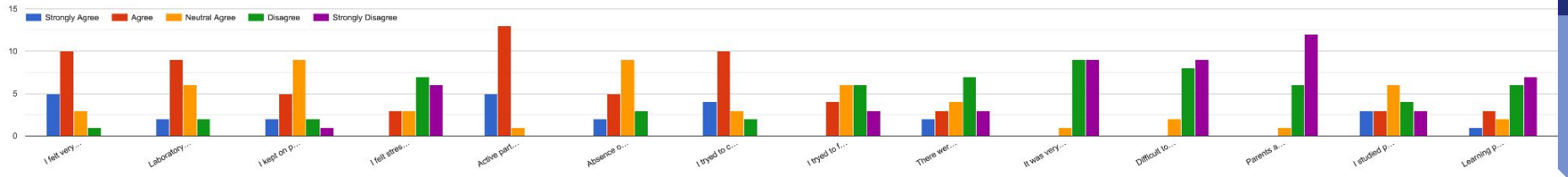


What did you do to improve your conceptual meaning of physics laws?

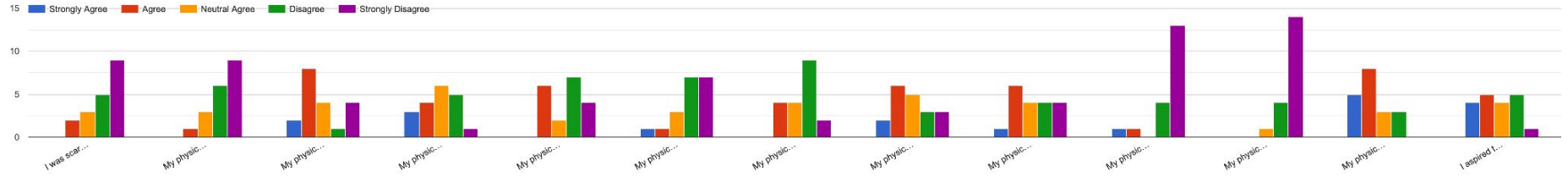
19 risposte



Physics learning experience (referring to your secondary school course)

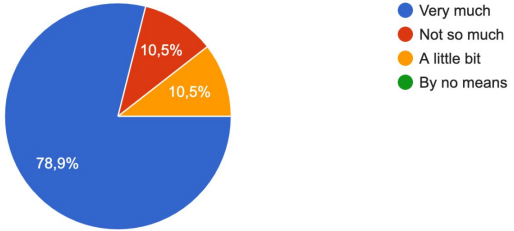


Physics teaching observation (referring to your secondary school course)



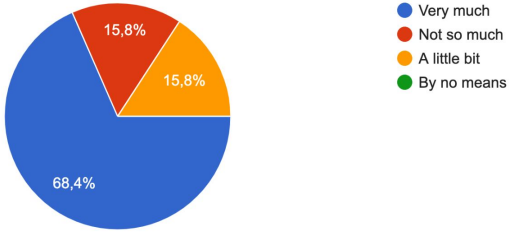
Did your Physics learning experience change during your university course?

19 risposte



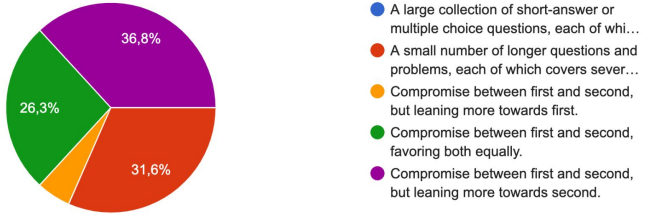
Did your Physics teaching observation change during your university course?

19 risposte



Of the following test formats, which is best for measuring how well students understand the material in physics?

19 risposte

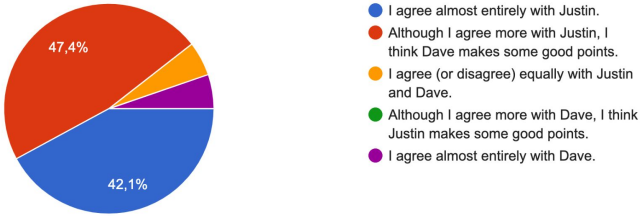


Brandon: "A good physics textbook should show how the material in one chapter relates to the material in other chapters. It shouldn't treat each topic ... With whom do you agree?

19 risposte

Justin: "When I'm learning physics concepts for a test, I like to put things in my own words, so that they make sense to me." Dave: "But putting things... learn things the way the textbook presents them."

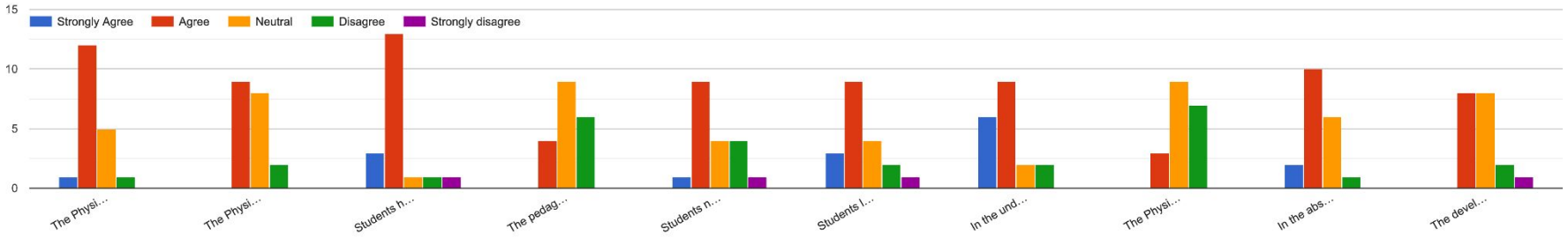
19 risposte



Imagine you are teaching physics at high school and you want to make your students familiar with the concept of block and tackle. Would you do so by:

19 risposte

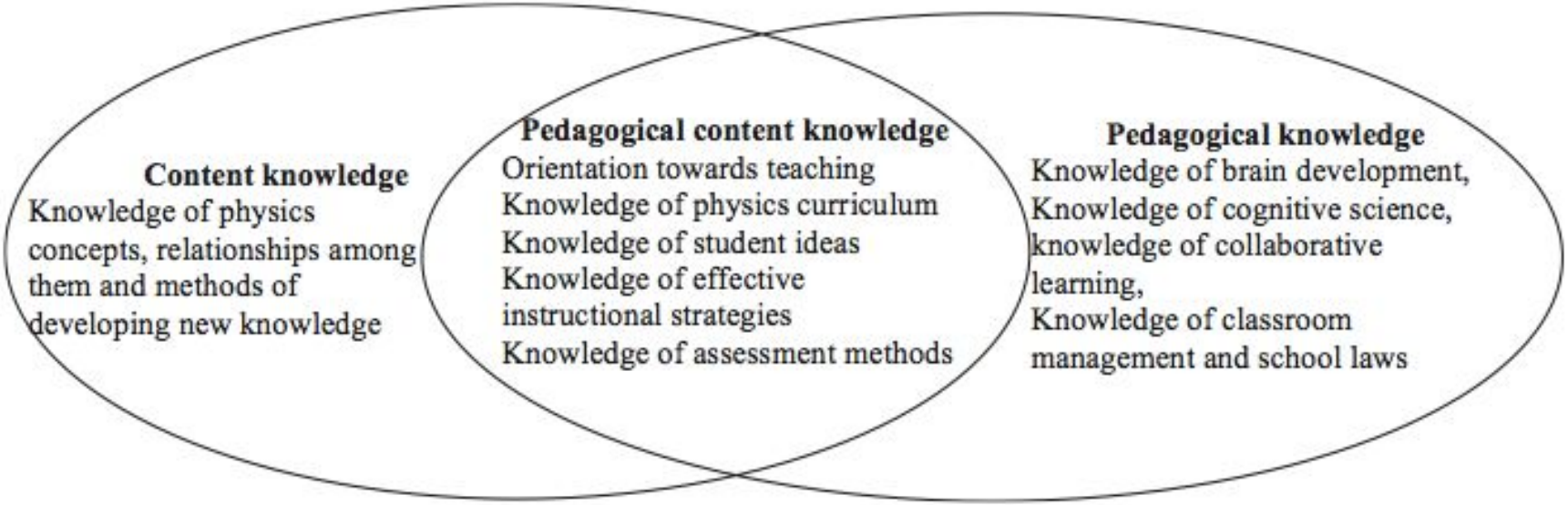
Interaction between Epistemology, Sociology, Learning and Teaching in Physics



“What shall I do with my students to help them understand this physics concept? What materials are there to help me? What are my students likely to already know and what will be difficult for them? How best shall I evaluate what my students have learned?" These questions are common for every teacher, and central to describe the knowledge that distinguishes a teacher from a subject matter specialist.

The Structure of Physics Teacher Knowledge

(Fazio, 2010)



Features of this tripartite structure

Content Knowledge
or Subject Matter Knowledge

Deep content knowledge is a necessary condition for the development of PCK.

If teachers themselves do not understand the nuances of a concept, the deep relationships between this particular concept and other concepts, and the ways through which this concept was constructed by the physics community, then translating these nuances into students' understanding is impossible.

Pedagogical Knowledge

Understanding of the processes of learning is crucial for the development of the orientation toward teaching, assessment methods, understanding of the role of student ideas, etc.

For example, the awareness of the complex nature of brain activity should affect how teachers deal with what is widely perceived as "student misconceptions"

Pedagogical Content Knowledge

PCK is highly domain specific; therefore, it is *critical that future teachers develop teachers' PCK in the specific topics that they will be teaching.*

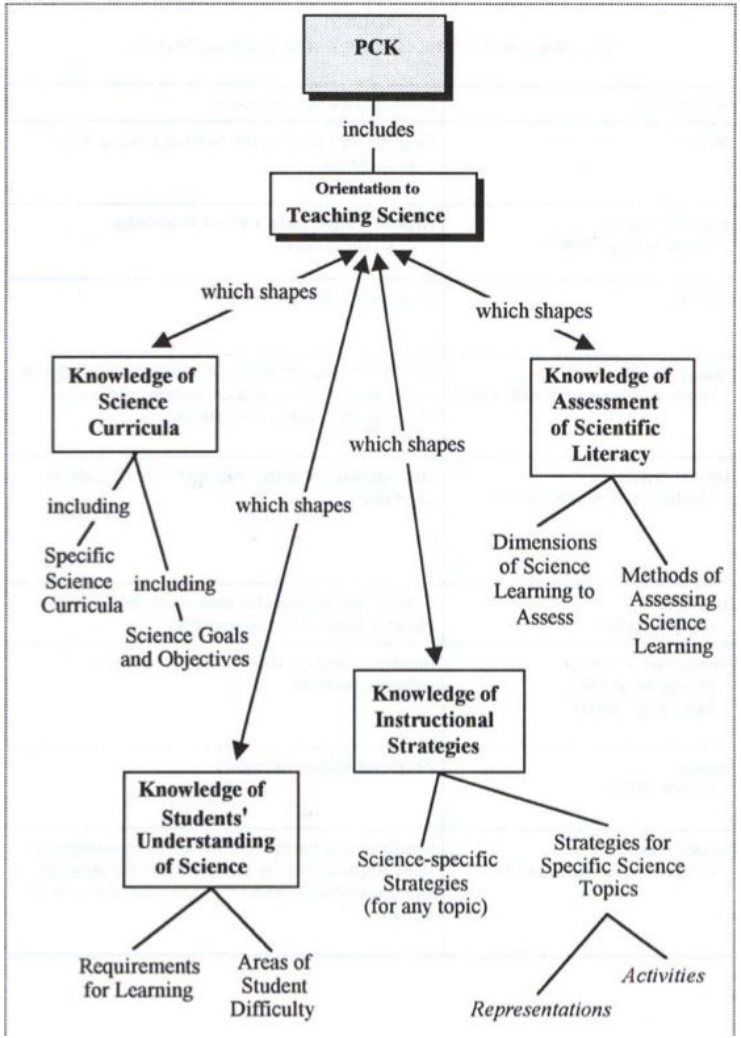
This is particularly relevant in the sciences; the different disciplines such as biology, physics, and earth science have distinct teaching methodologies, curricula, and instructional sequences.

PCK represents a teacher ability to convey the relevant constructs of the content knowledge in a manner that makes it accessible to their students.

The most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations ... including an understanding of what makes the learning of specific concepts easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning. (Shulman, 1986b, p. 9)

PCK definition in Science Teaching

(Magnusson et al., 1999)



- orientations toward science teaching
- knowledge and beliefs about science curriculum
- knowledge and beliefs about students' understanding of specific science topics
- knowledge and beliefs about assessment in science
- knowledge and beliefs about instructional strategies for teaching sciences

Five aspects of PCK and their relationship to Physics Teaching

(Etkina et al., 2010, p.3)

Orientations toward Science Teaching

Beliefs regarding the role of students' prior knowledge in their learning, the purpose of problem solving, the roles of experiments in the classrooms, what motivates students in the classroom, etc.

Knowledge of curricula

The knowledge of the sequence of topics that allows a student to build the understanding of a new concept or skill on what she or he already knows.

Knowledge of students' prior understandings about and difficulties with key concepts and practices in science.

Knowledge of students' pre-instruction ideas when they are constructing a new concept. Knowledge of difficulties students may have interpreting physics language that is different from everyday language.

Knowledge of instructional strategies to scaffold students’ learning of key concepts and practices in science.

Knowledge of multiple methods or specific activity sequences that make student learning more successful and an ability to choose the most productive strategy or modify a strategy for a particular group of students or an individual.

Knowledge of what to assess and specific strategies to assess students’ understandings of key concepts and practices.

Knowledge of ways to assess student conceptual understanding and problem solving and general scientific abilities; knowledge of how to help students self-assess their work and to engage in a meaningful reflection.

Self-reflecting teaching...

Is it present a PCK or not? Which PCK do you recognize? Which pattern is prevalent?

https://www.youtube.com/playlist?list=PLAA7AA6B0E433653C PSSC - Physical Science Study Committee

https://www.youtube.com/watch?v=CDEDBXuwYvo Fisica della professoressa Ida

https://www.youtube.com/watch?v=AsNxXS3kYho “Te lo avevo detto” - INCIDENTE SENZA CINTURE

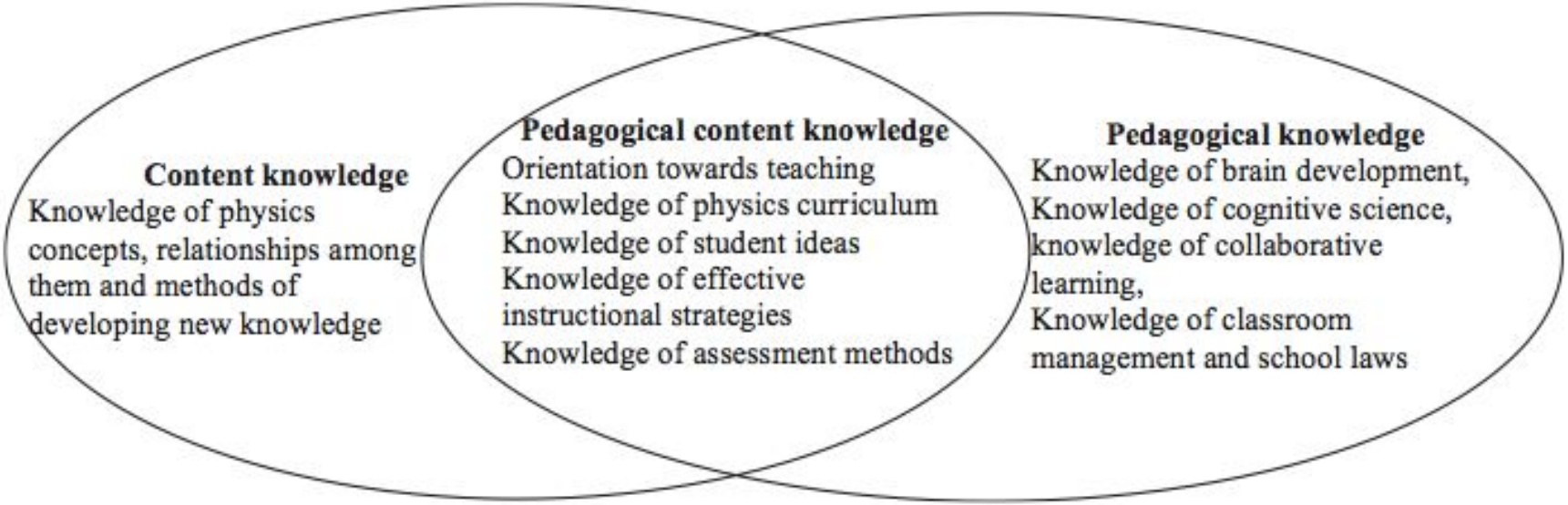
https://www.youtube.com/watch?v=kxHdVw-mh24 “Te lo avevo detto” - RAMPA SKATEBOARD

https://www.youtube.com/watch?v=282D-YkMxyI PoliMi - Storia del primo principio

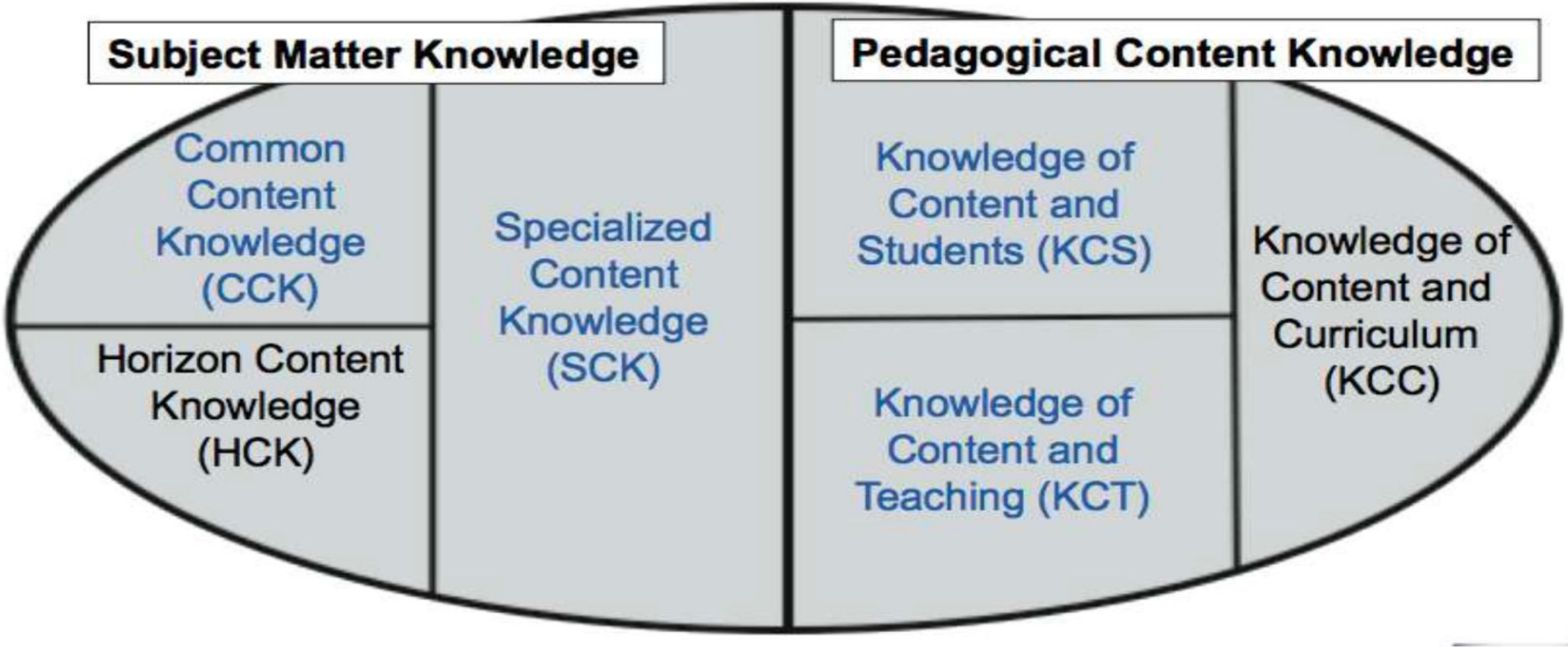
https://youtu.be/p0zDfi_8TKo FisicaFast

The Structure of Physics Teacher Knowledge

(Fazio, 2010)

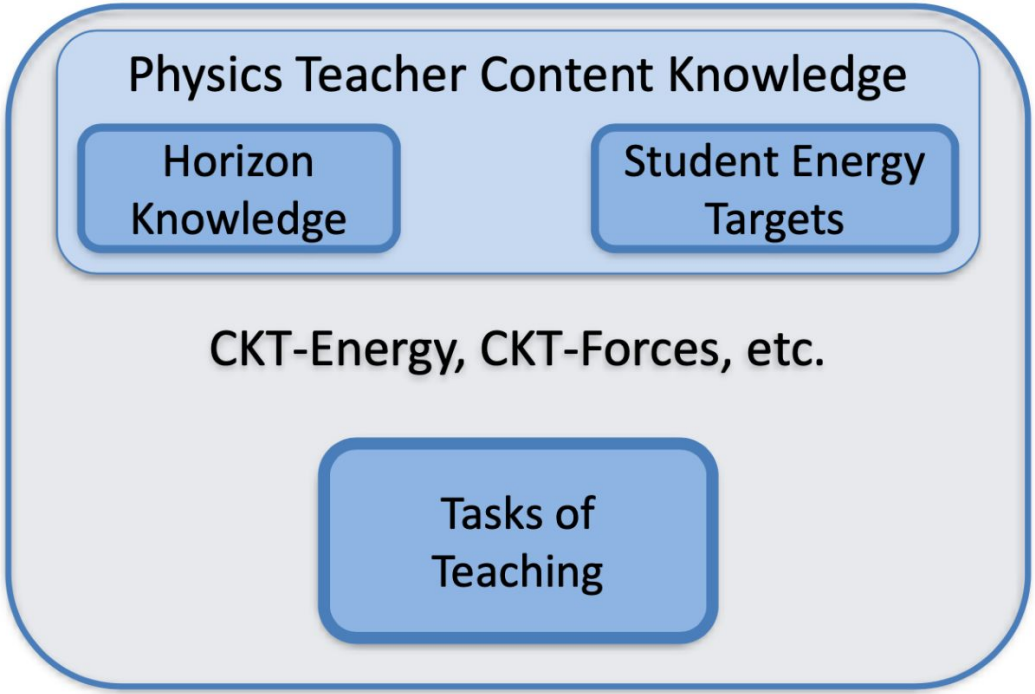


Knowledge: Model of Content Knowledge for Teaching (CKT) a specific subject

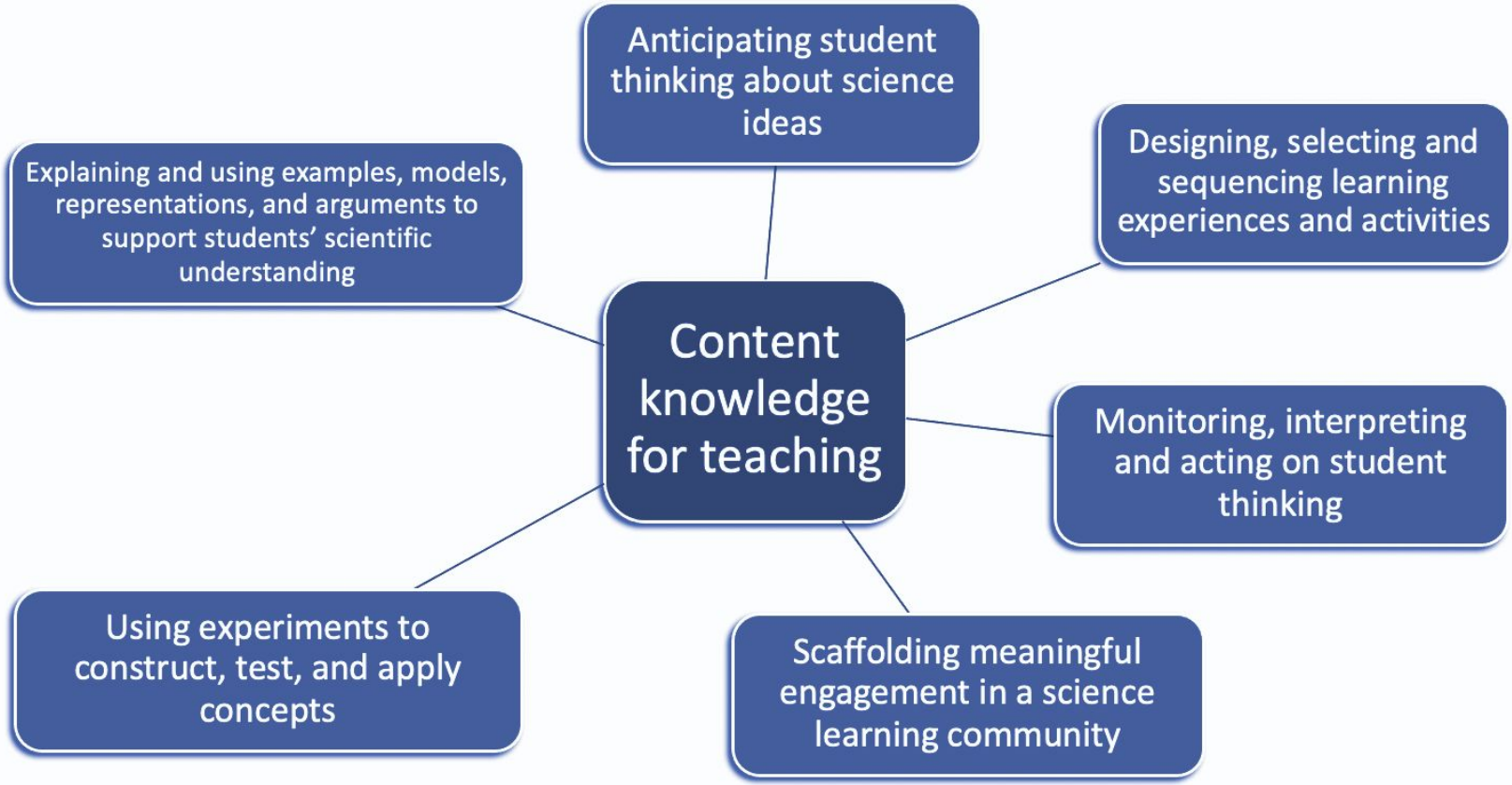


Ball, Thames, and Phelps (2008)

Development of CKT model for physics



Etkina, Gitomer, Iconangelo, Phelps, Seeley, & Vokos (2018) Teachers' Content Knowledge for Teaching: An example from energy in HS physics, Physical Review, Physics Education Research, 14, 010127.


Anticipating student thinking about science ideas
Designing, selecting and sequencing learning experiences and activities
Explaining and using examples, models, representations, and arguments to support students' scientific understanding
Content knowledge for teaching
Monitoring, interpreting and acting on student thinking
Using experiments to construct, test, and apply concepts
Scaffolding meaningful engagement in a science learning community

Etkina, 2018