Science Learning Progressions, Discourse, and Teacher Pedagogical Content Knowledge

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Acknowledgment

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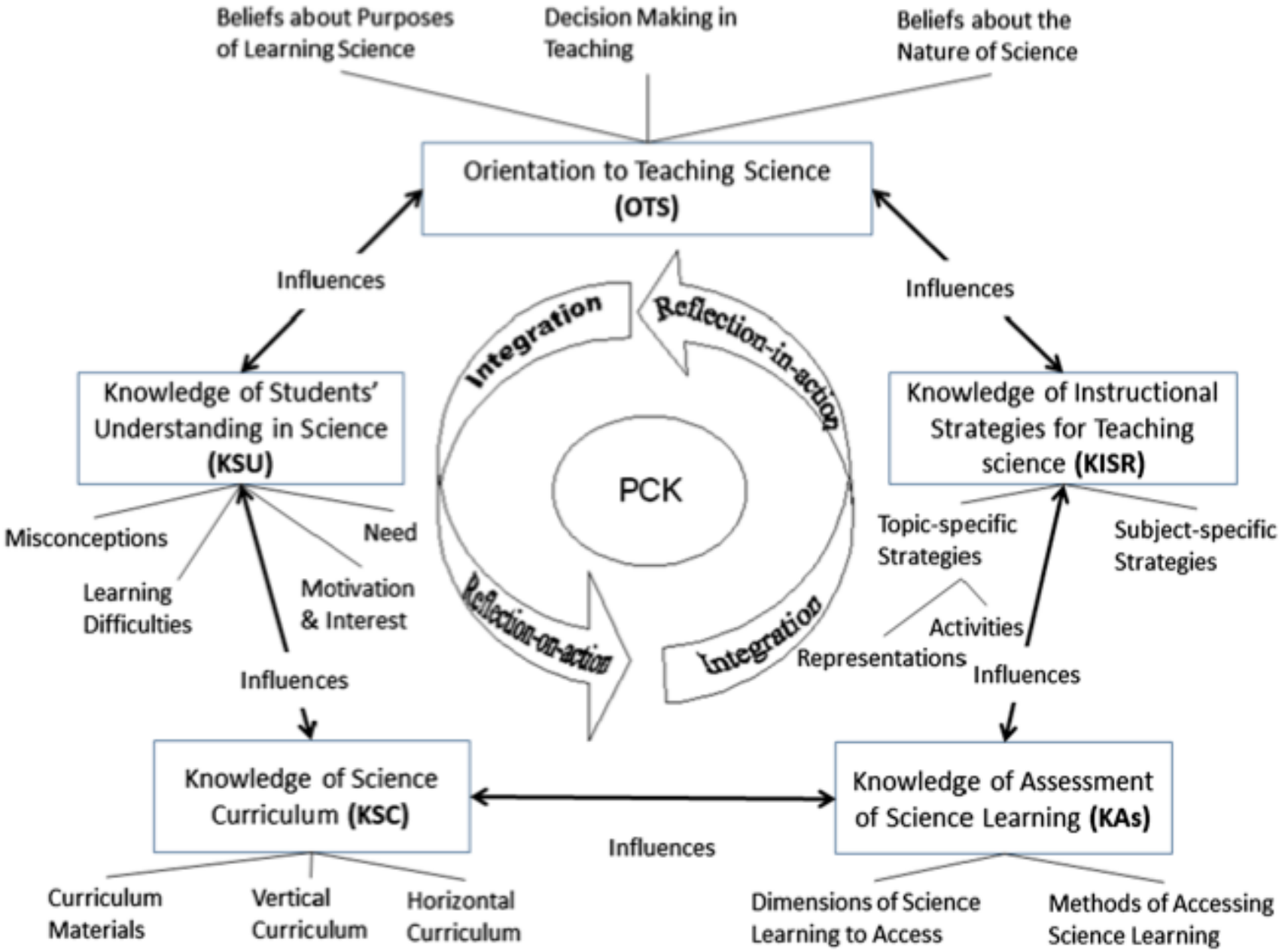
Any opinions, findings, conclusions, or recommendations expressed are those of the authors and do not necessarily represent the policies or views of the funders.



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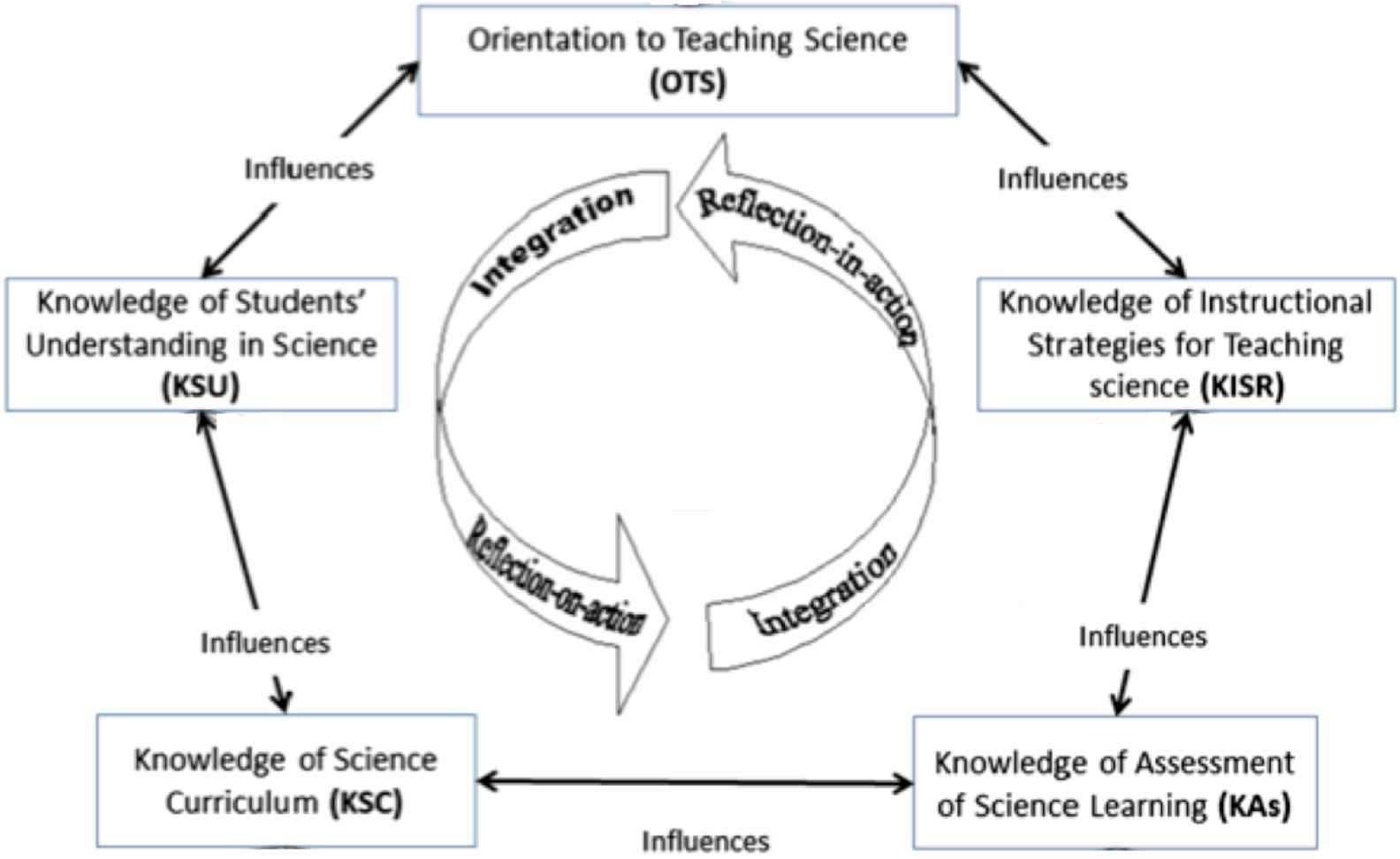

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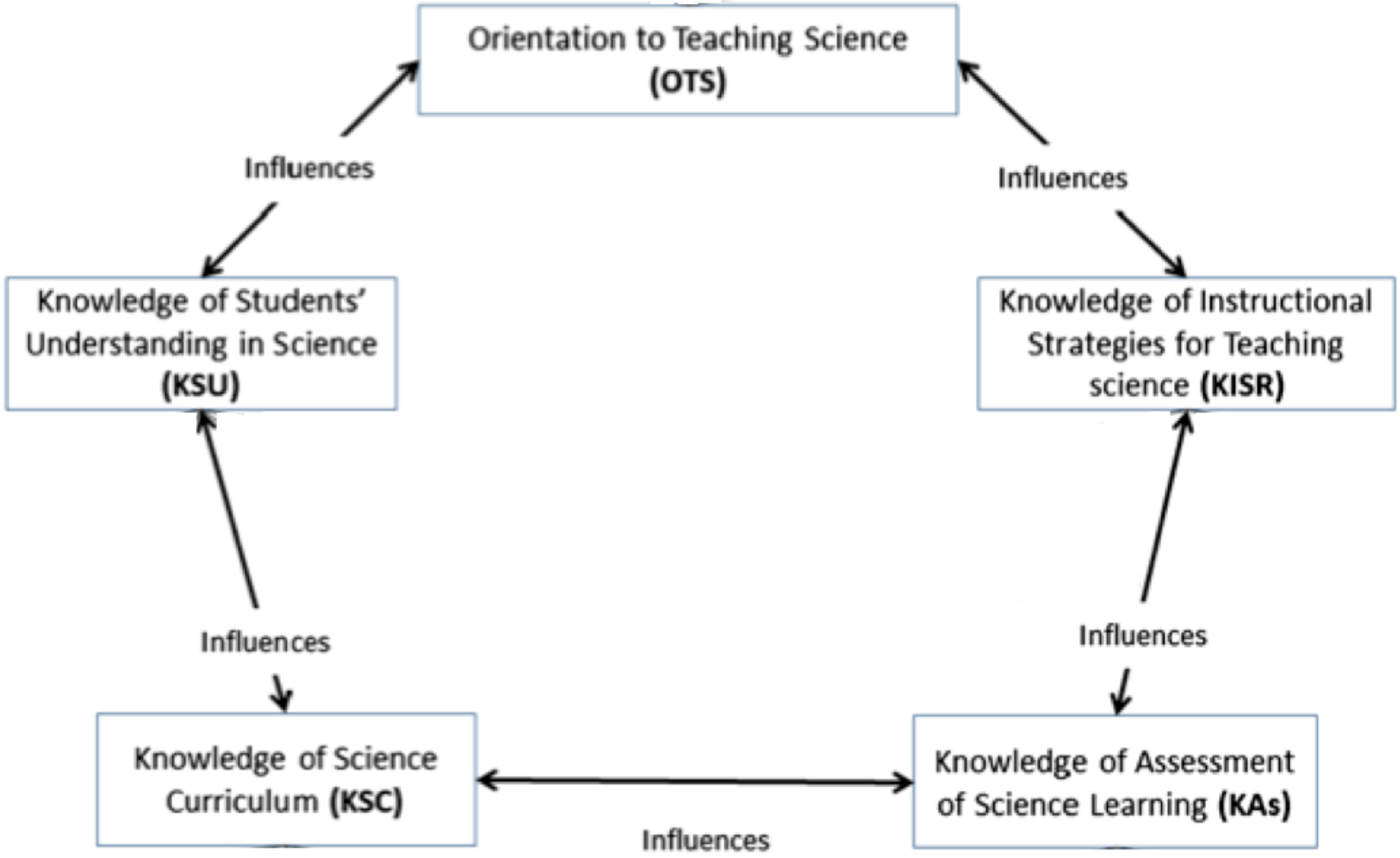

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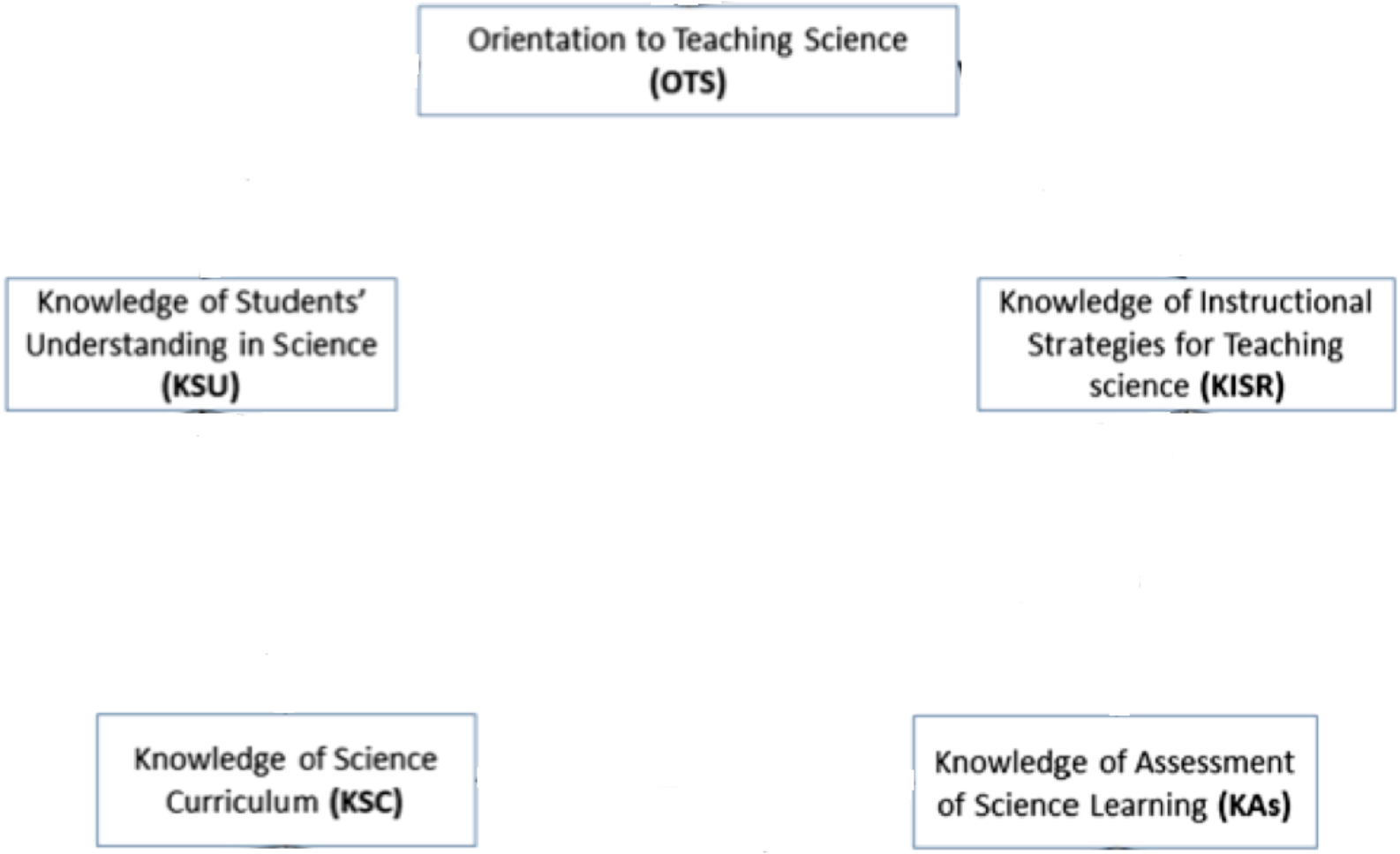

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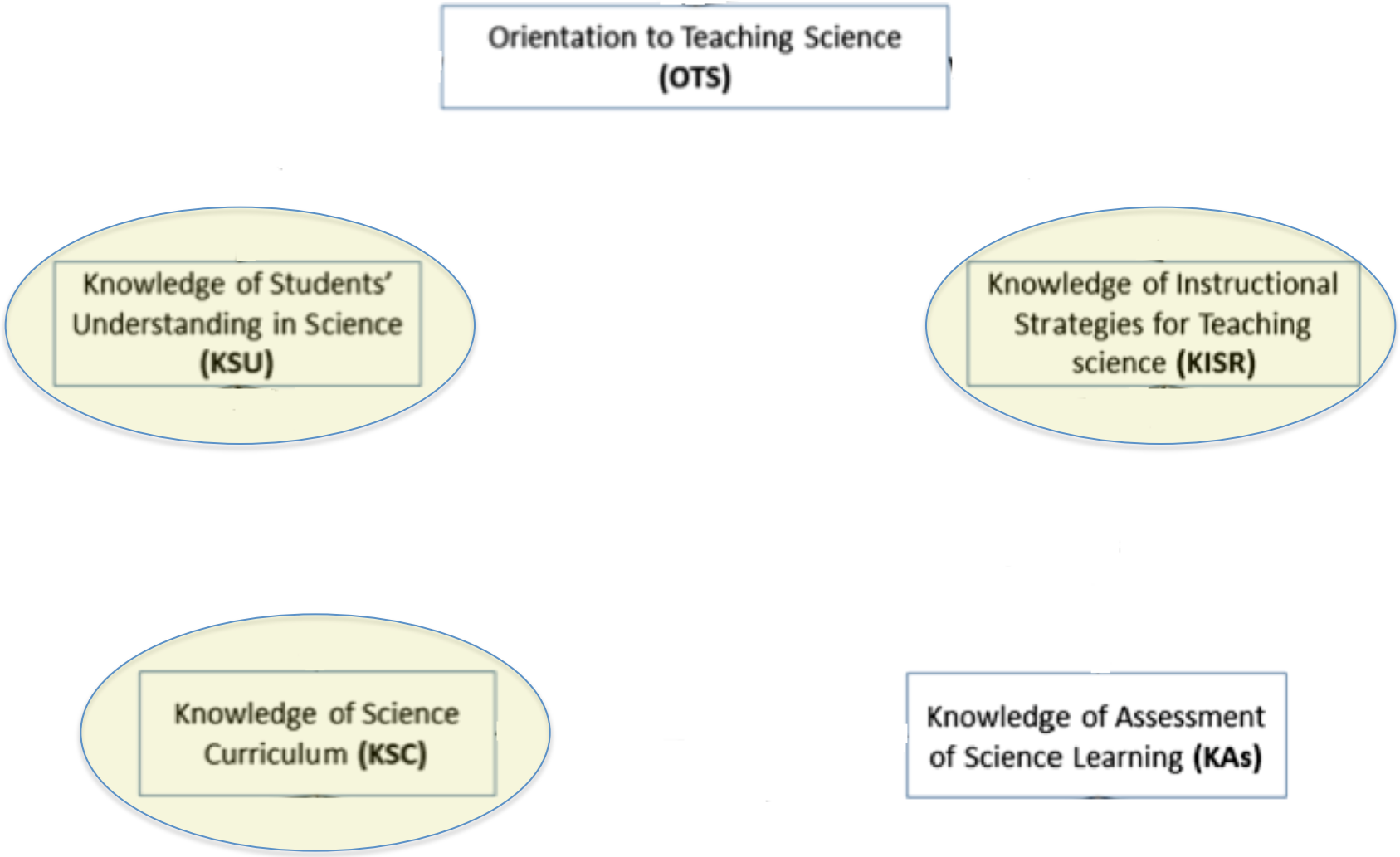

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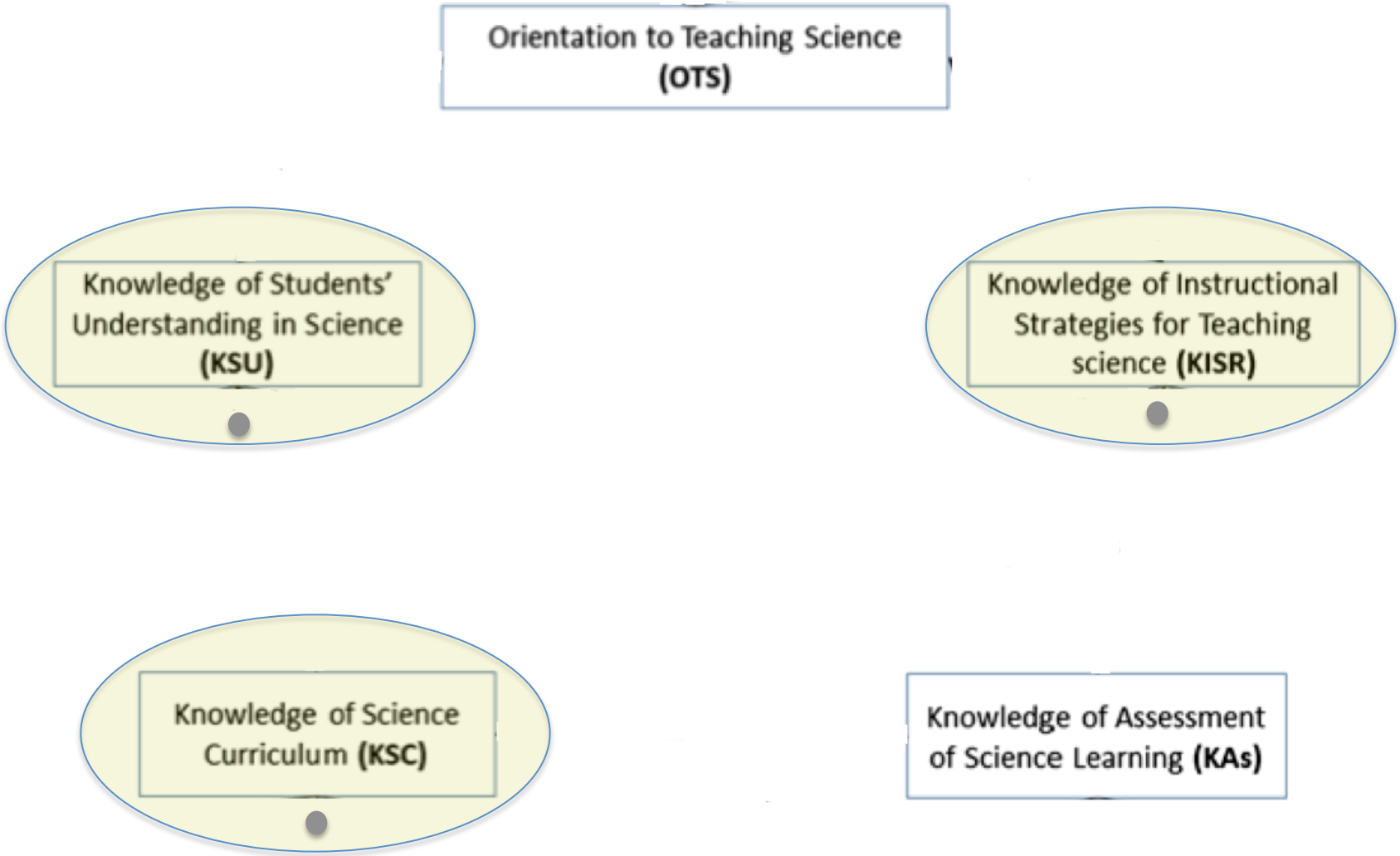

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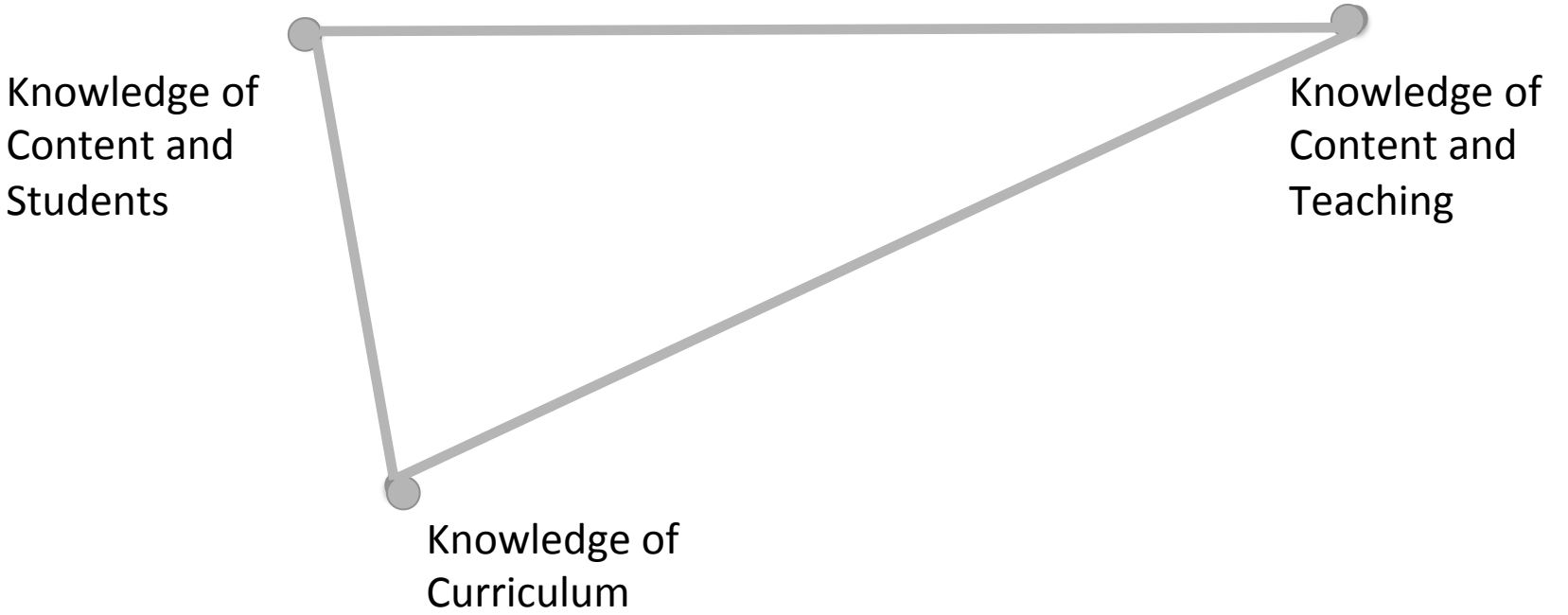
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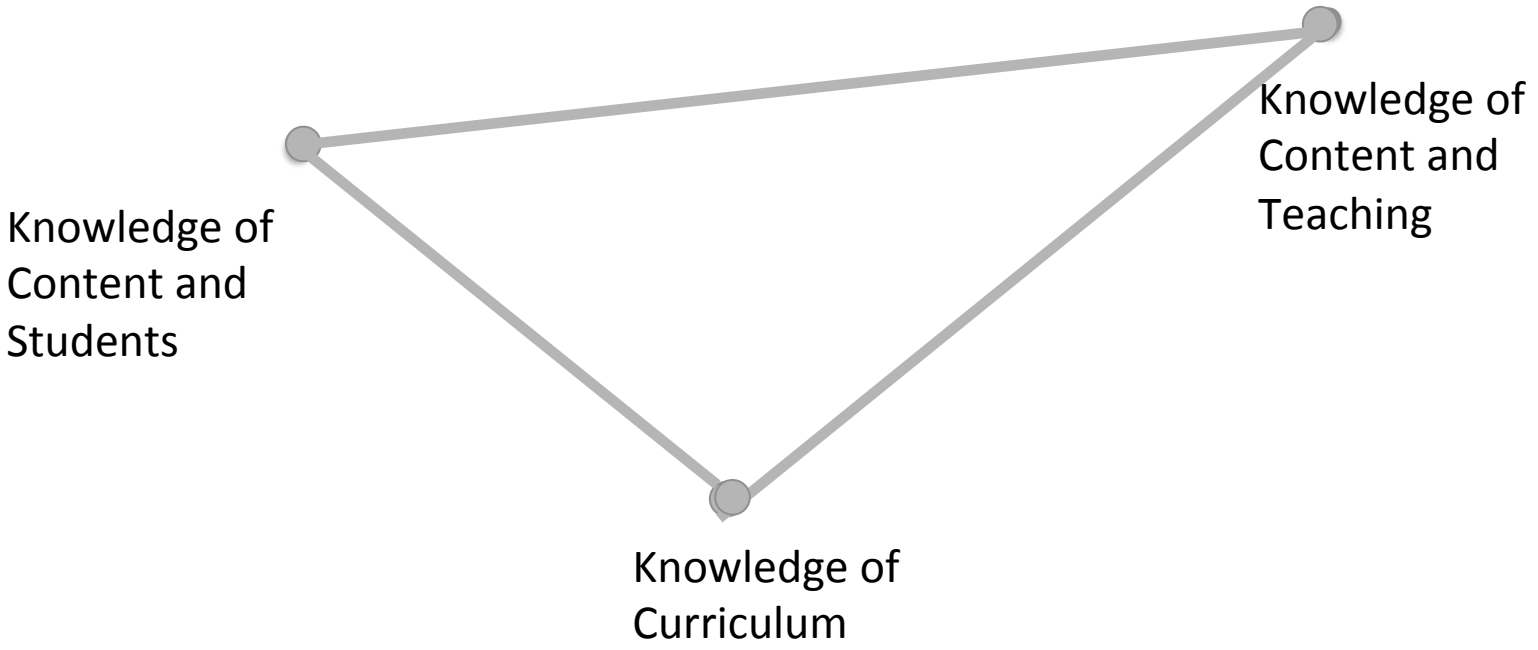
Knowledge of Content and Teaching
Knowledge of Curriculum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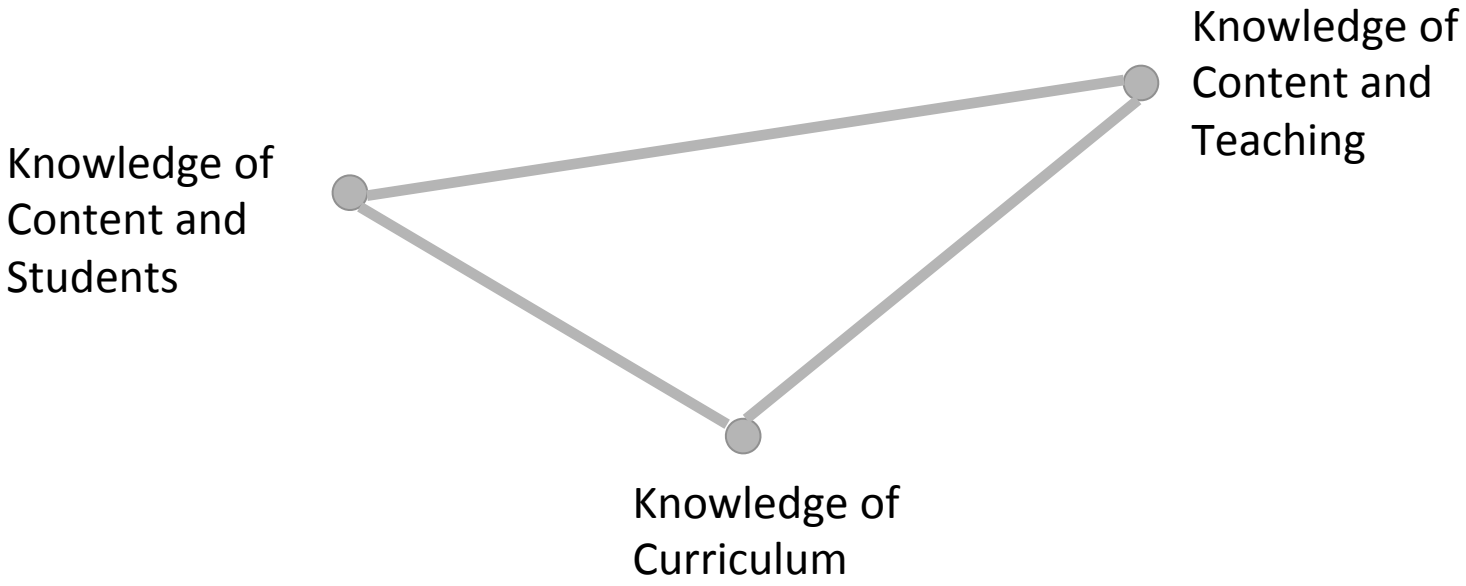
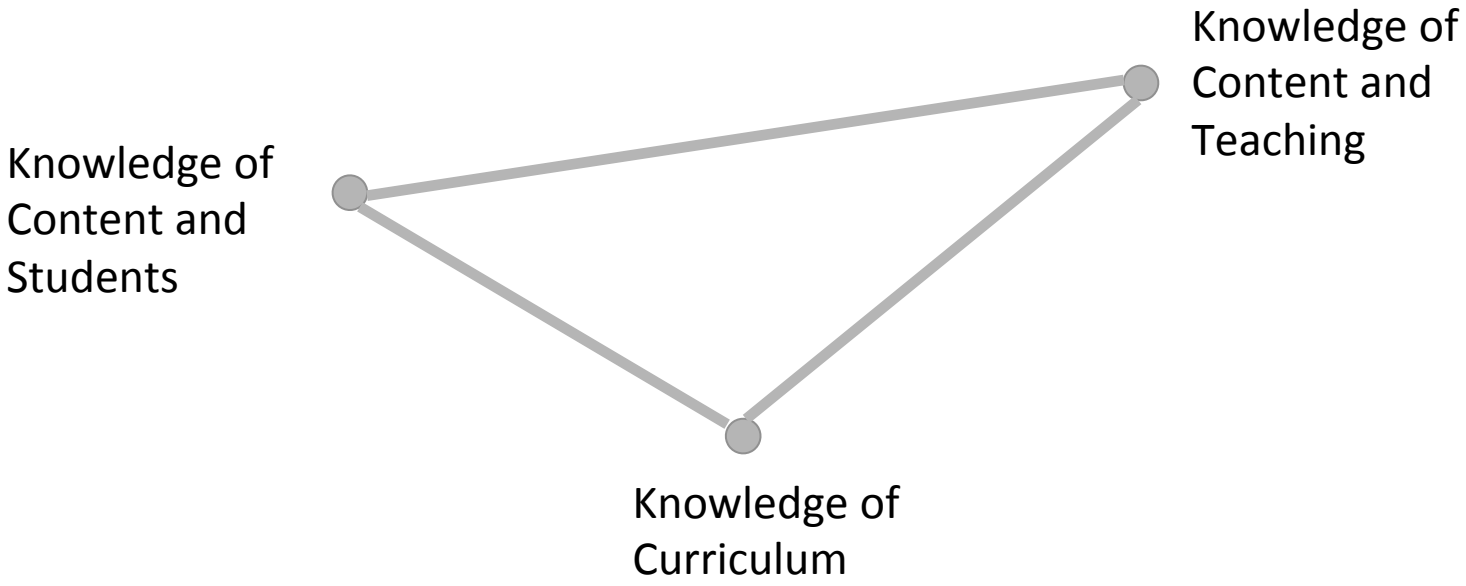
Existing Theory

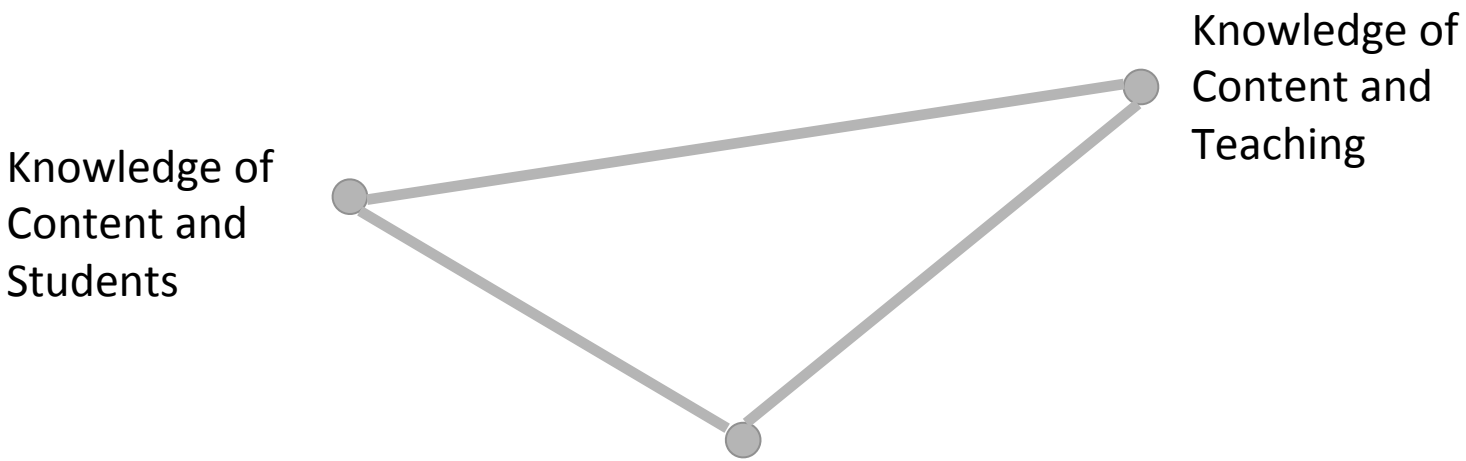


Existing Theory

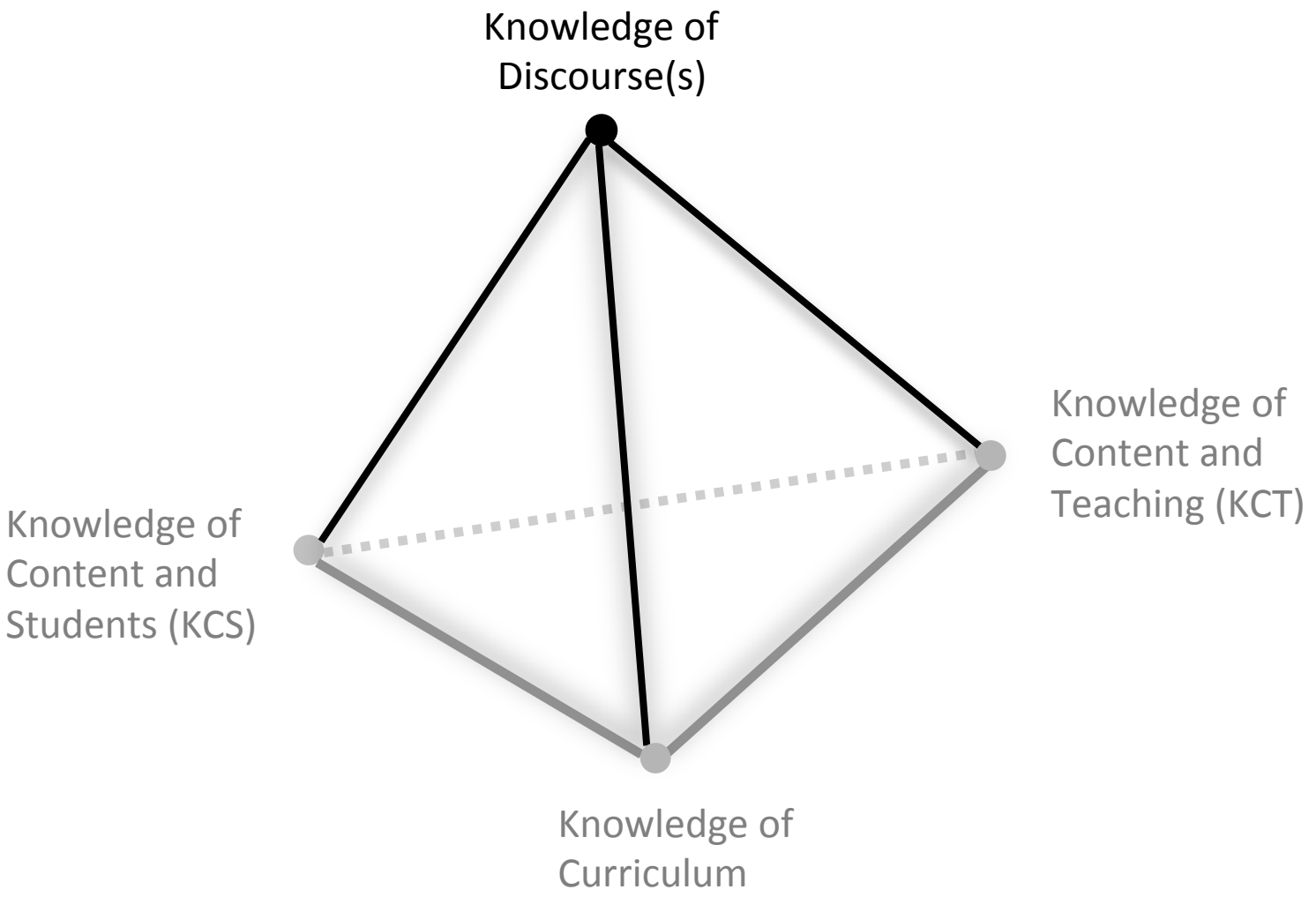


Extended Theory

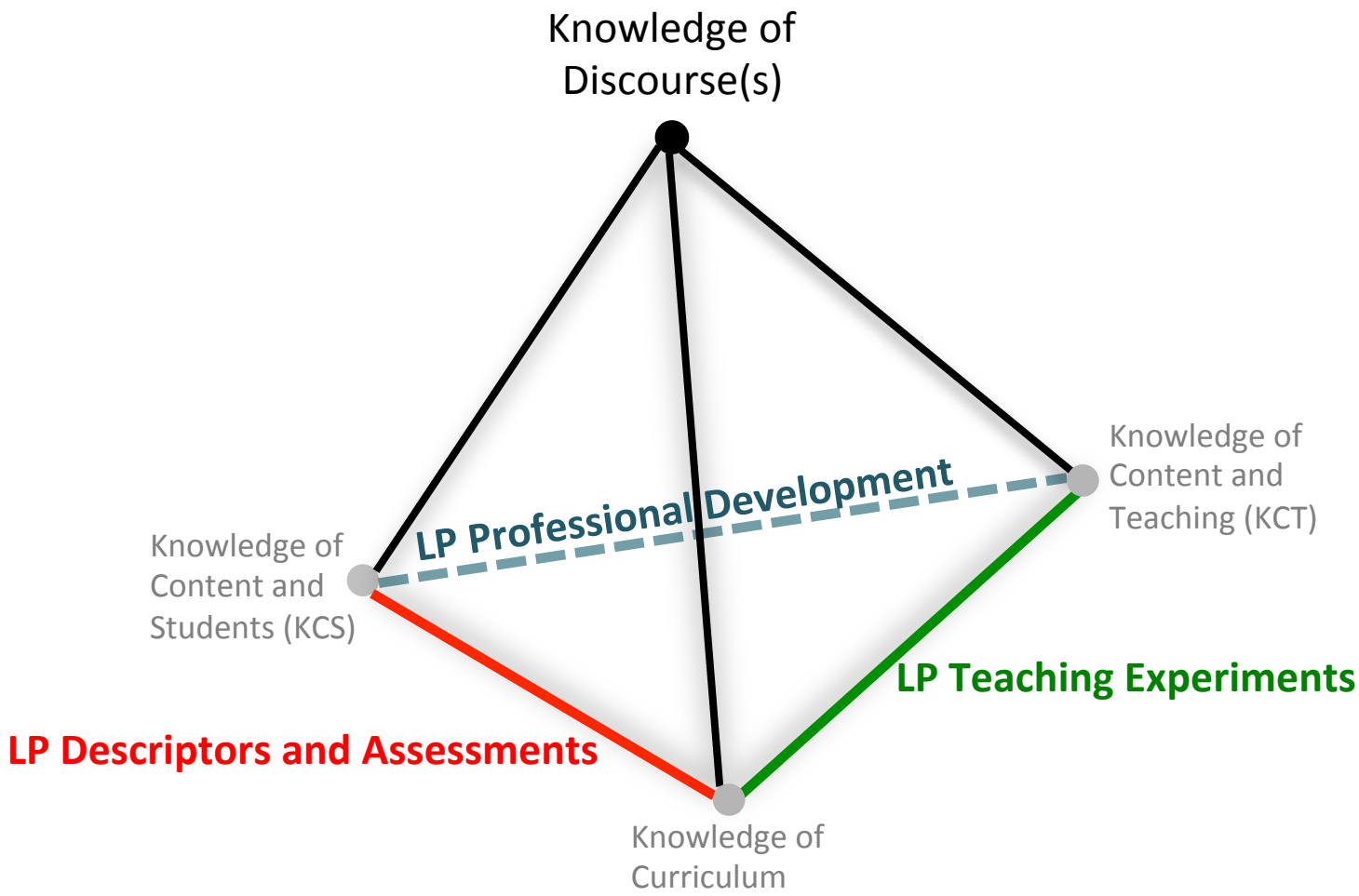
Knowledge of
Discourse(s)



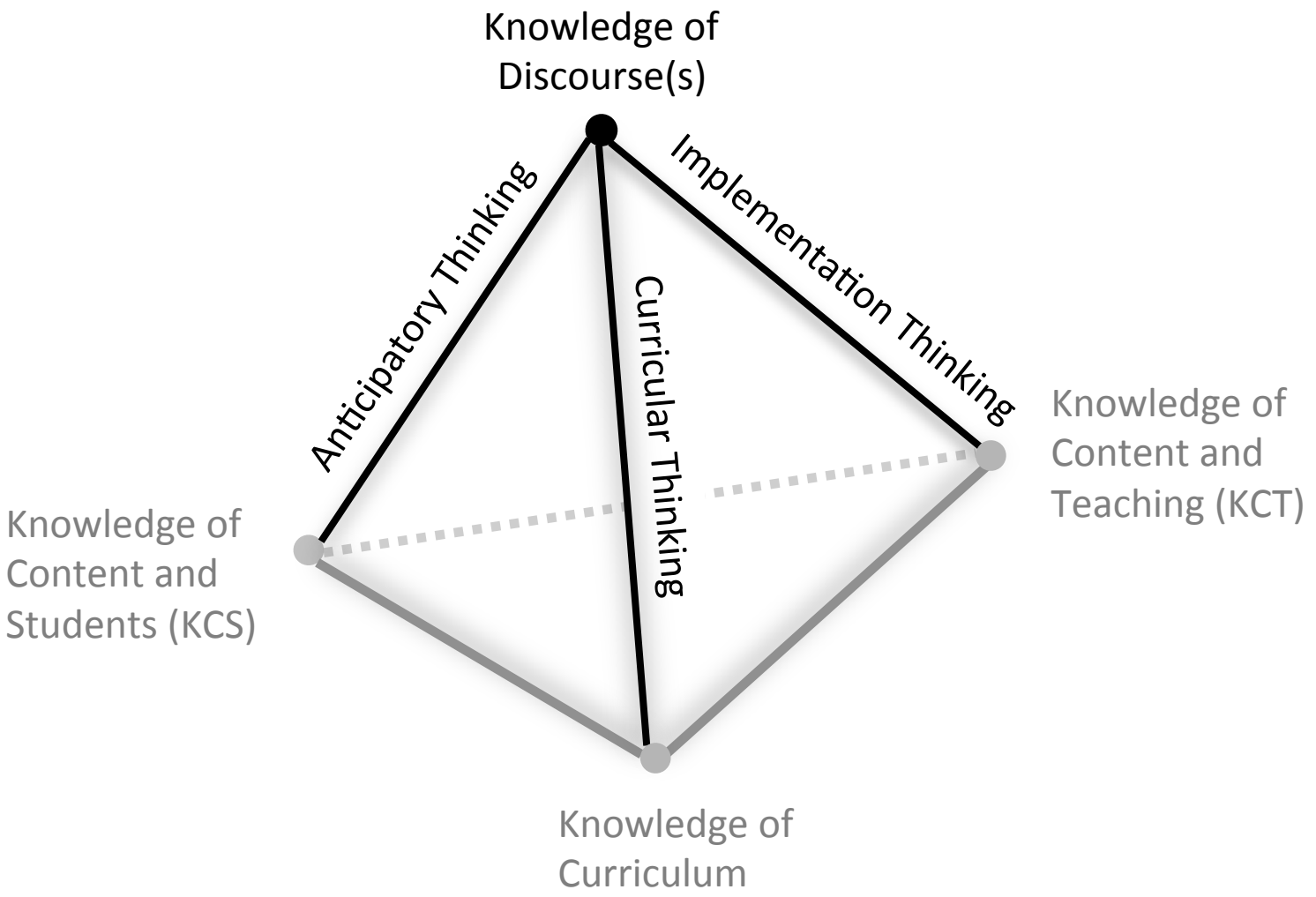
Extended Theory



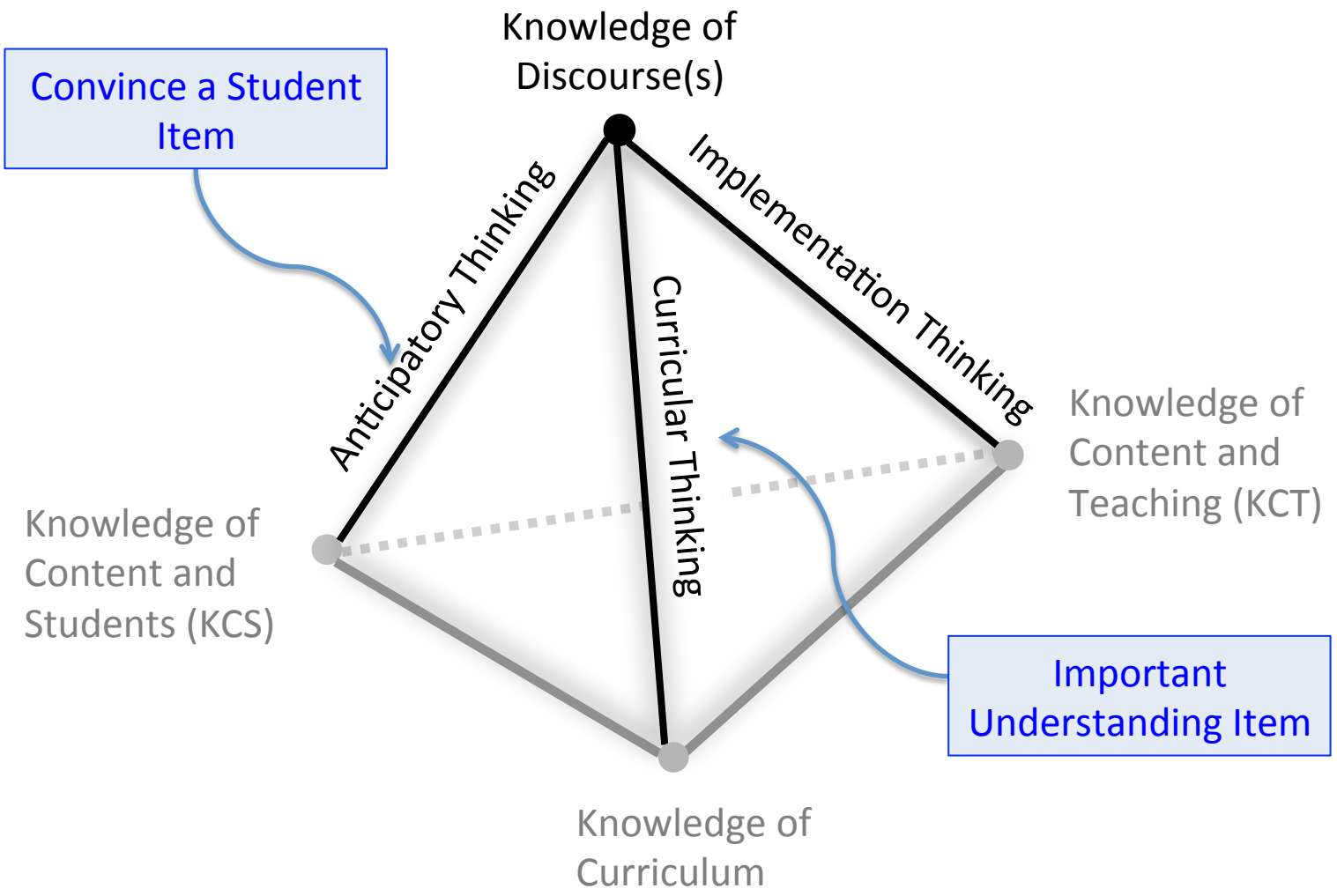
Project Resources



Model for PCK



Items Related to PCK



Prompts

Important Understanding:

List the most important understanding for this topic that students in this particular course should master by the end of your instruction. Be as specific as possible, considering the grade, course and context of your class.

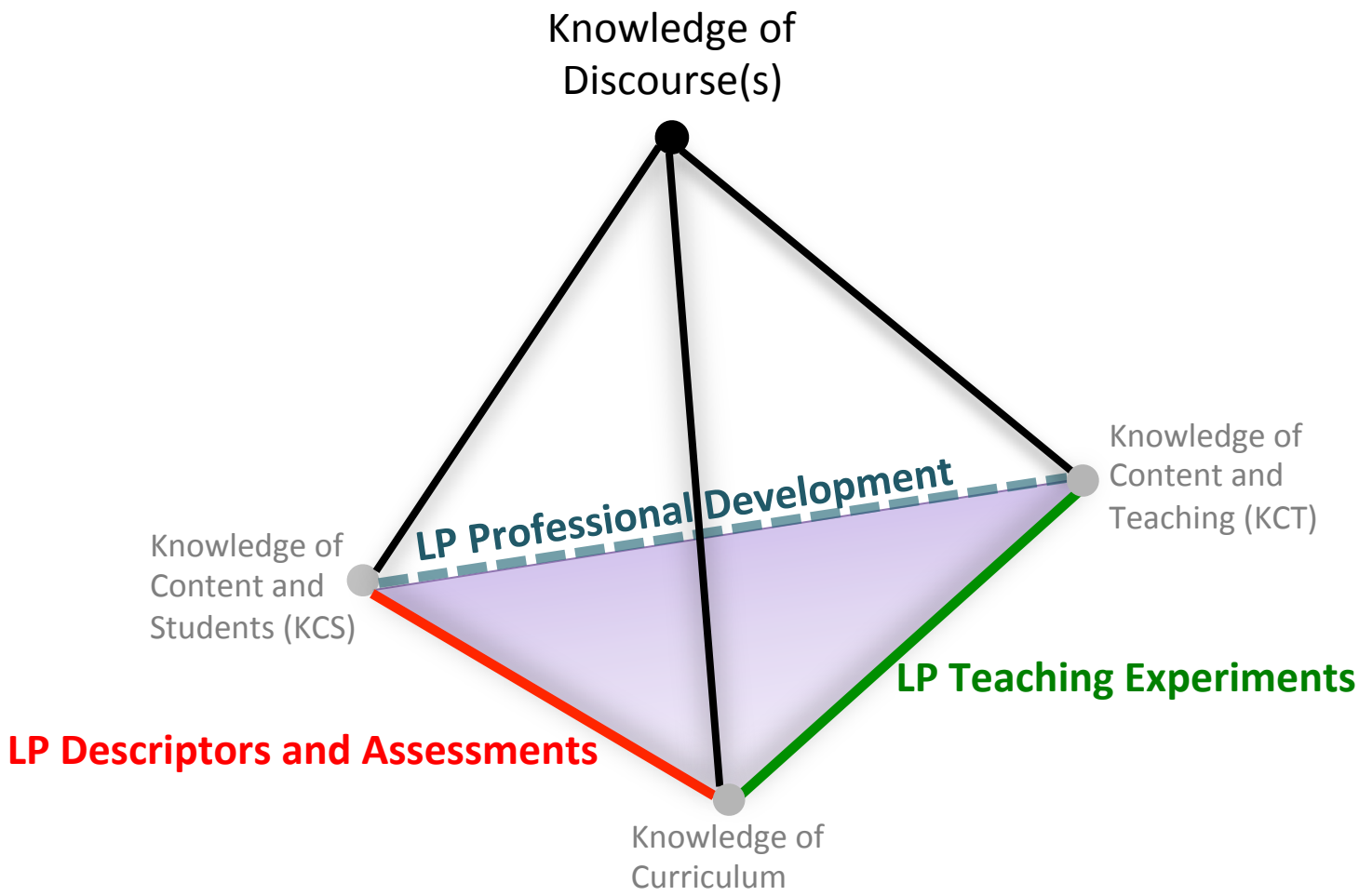
Convince a Student:

If you had to convince a student in the course that the understanding you listed was important for their everyday life, what would your argument be?

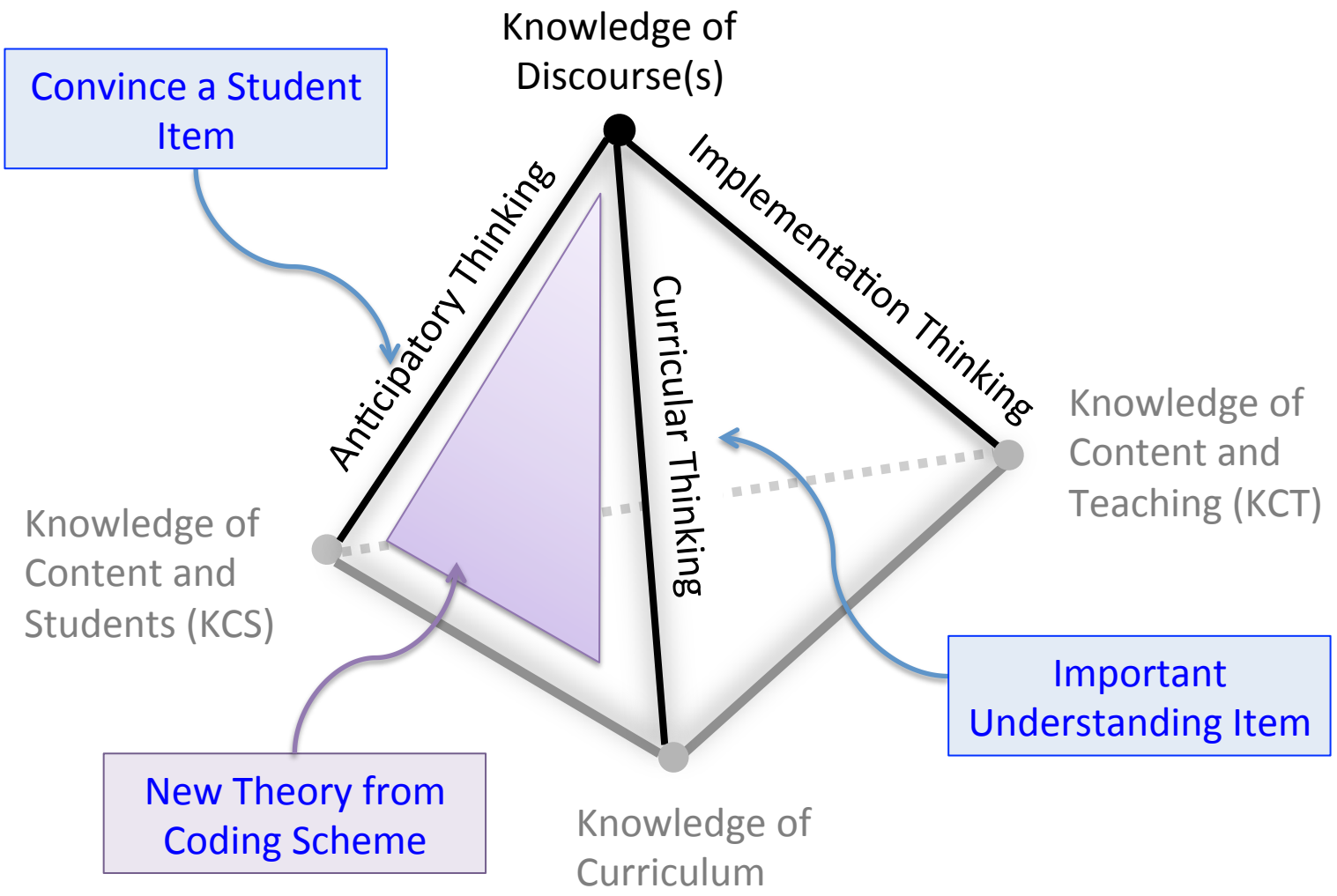
Summary Results

	New Teachers	Continuing Teachers
Important Understanding	30% Significant gain	17%
Convince a Student	4%	21% Significant gain

Development – Next Steps



PCK Model – Next Steps



Thank you!

JiC Slides

Just in case someone asks…

Describe an Important Understanding

	Change Paired t-test	N Pop (Pairs)	2011 Mean (SD)	2012 Mean (SD)
New in 2011	Gain, **significant** $p<0.000$	49 (28)	1.06 (0.3)	1.50 (0.6)
Cont in 2011	Gain, not significant $p=0.3$	44 (24)	1.48 (0.6)	1.58 (0.7)
End	Gain, *near significant* $p=0.08$	27 (20)	1.25 (0.6)	1.38 (0.5)

Convince a Student

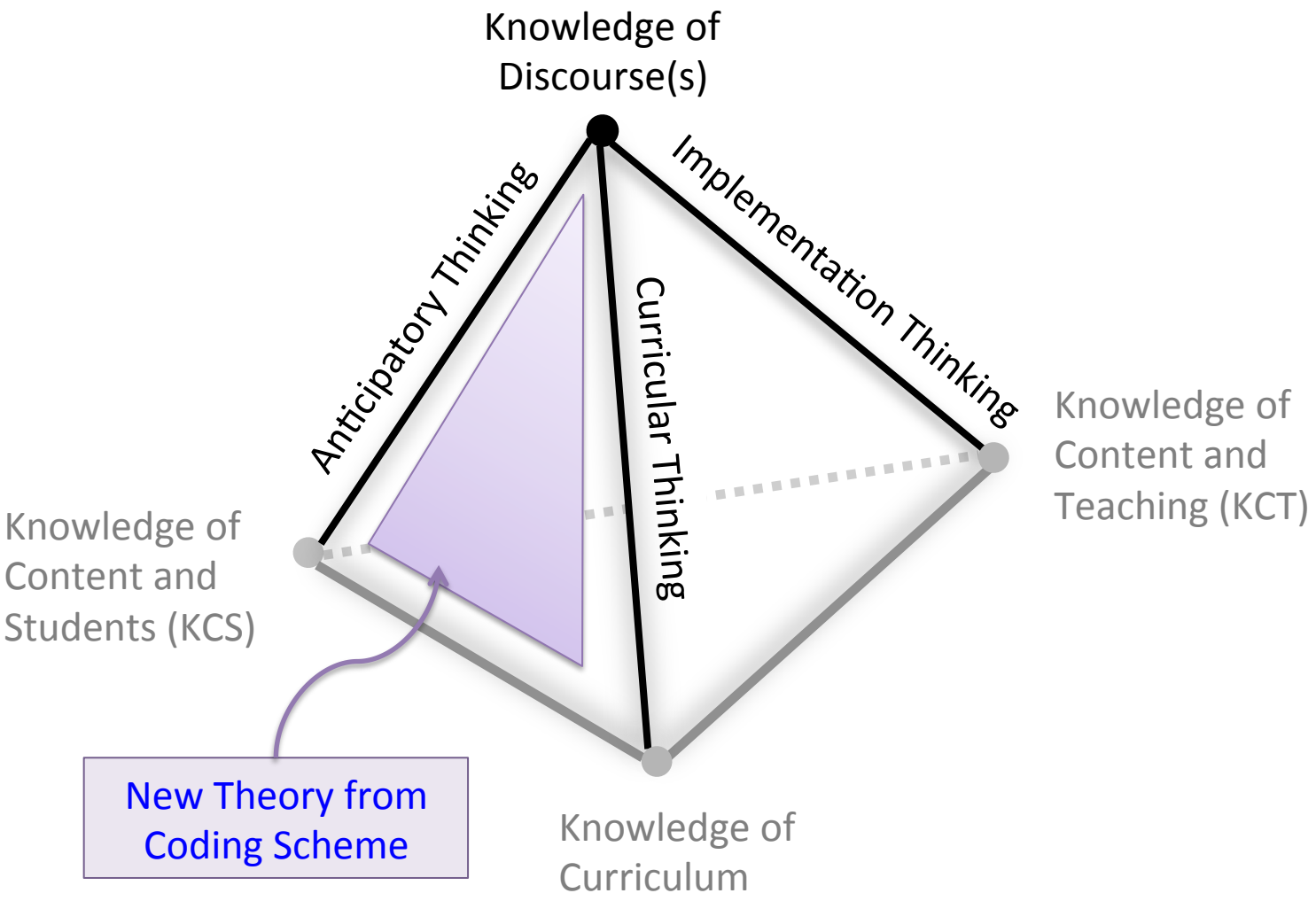
	Change Paired t-test	N Pop (Paired)	2011 Mean (SD)	2012 Mean (SD)
New in 2011	Gain, not significant *p*=0.35	50 (28)	1.78 (0.6)	1.83 (0.6)
Cont in 2011	Gain, **significant** *p*=0.04	43 (24)	1.77 (0.6)	1.98 (0.6)
End in 2012	Gain, **significant** *p*=0.02	24 (7)	1.56 (0.5)	2.00 (0.7)

Implications - Questions

Development. How might Learning Progression-based materials (descriptions, assessments, teaching experiments, professional development) be a resource for intentional effort towards enriching Knowledge of Discourse(s)?

Theory. Our codes for Convince a Student seem more broadly applicable – How might we build new model/theory from them?

PCK Model – Next Steps



Convince a Student – Code 1

Asserting. Statement(s) of fact or question(s) without explicit connection to students' experience.

Examples

24. Biodiversity increases the richness of life.

32. Without carbon life on earth as we know it would not exist.

Convince a Student – Code 1.5

Statement(s) of fact or question(s) with possibly implicit connection to general human experience

Examples

11. Water is one of the basic and fundamental abiotic materials needed for life. Number 1 would be oxygen (life would end in a matter of minutes without it), water probably number 2 (days), and food number 3 (could survive potentially for a week without food).

69. Plants produce O2 we need to breathe as well as a source of glucose we need for energy to complete normal everyday tasks and growth.

Convince a Student – Code 2

Comparing. There are distinct systems, including human systems. Some connection to student experience, possibly through "should" messages or analogies, usually using compare/contrast.

Examples

29. I would compare what plants need to grow and be healthy to what we as humans need to grow and be healthy. Students would work on the similarities and differences between plant and human needs.

77. Let's take a cob of corn, for example. Together, we would trace the path that ultimately allows for a cob of corn to get to the table. It would be a discussion that starts with the cob of corn- how did the corn grow? To make for a more complex example, I would use a hamburger as an example.

Convince a Student – Code 2.5

More student-relevant detail, focus still on separation of systems

Example

35. I would relate it to them and their personal experiences. For example, in Ventura excess blooms of plankton result in a red tide of that plankton that produce a toxin that then gets magnified through the food chain and causes marine mammals to get sick and beached . The public sees the marine mammals and the city workers will tape an area around the mammal so the general public leave the animal alone. Also, people are not suppose to eat the filter feeders like mussels during certain months(ending in r) as they will have too many toxins due to this maginification. It is important to make it relevant to them.

Convince a Student – Code 3

Collecting. We are all in this together messages; student-relevant details on human and (other) animal common needs and resources. Usually includes "you should care because we all do" or "harm to one being is harm to us all" implicitly or explicitly.

Example

15. What did you have for lunch? Did you know that nothing in your lunch would exist without photosynthesis? Even if you had a steak, that steak came from a cow that got it's energy from it's food, grass. The grass got it's energy from the sun and stored it in a process called photosynthesis. The cow got it's energy by 'stealing' stored energy from the grass. We got our energy, by 'stealing' and using stored energy from the cow.

Convince a Student – Code 3

45. Natural selection is the mechanism responsible for the distribution, numbers, and appearance of all living things in the world, from plants to people. Living things, including people, adapt to their surroundings to access the limited water, food, shelter, and air available to them. All organisms, even people, also have ways to avoid danger and to propagate their genes. It is important for everyone to know that they are part of the natural world and subject to these laws; that adapt and survive is not just something that happens in the jungle, but every place, every day. When it's cold, we bundle up. If we didn't we might get sick. When we grow up, we must find a job to acquire all the necessary resources to support ourselves and our families. Understanding how to nurture and support the environment around us, rather than further limiting the resources we need to survive, will be important to our own survival and quality of life.

Convince a Student – Code 3.5 or 4

High 3 that may border code 4 (language could be out of reach of students; no explicit statement about who the anticipated student audience is).

44. Evidence of human impacts are seen in real time phenomena such as global climate change. There are many aspects of this that can affect you personally. For instance, changes in precipitation and temperature patterns can alter the weather where you live, bringing more floods, droughts or other extreme events. Species losses not only mean that your children might never get to see a polar bear or manatee, but also that fruit that you enjoy will no longer be able to be grown because its pollinator has become extinct or that an exotic plant with a compound which could have been the cure for cancer was never discovered. Economically, the greenhouse gasses that cause many of our pollution problems will also become more scarce and more expensive, most likely sparking conflict in the world as they do so. Future jobs may center on finding alternatives and engineering solutions to the many impacts we have had on our global environment.

Convince a Student – Code 4

Synthesizing. There are multiple systems, including human(s), and human interaction with other systems involves cause/effect/consequence that may come back to affect humans. Implicit or explicit full cycle with student-relevant details at multiple reference points in the cycle; language of argument is readily accessible to students at multiple LP levels.

Possible example – see 3.5/4 example

Convince a Student – Code 5

Inventizing. There are many overlapping systems and complex interactions among them that can be exemplified in student-relevant/student-elicited experience; personal/communal experience can be transferably informative for understanding and modeling systems.

More detail on description of code: Multiple interacting systems linked to stated anticipations about student thinking and experience; argument may include dialogic components with explicit questions of students to elicit student-relevant links; humans as part of animal kingdom and as sub-system. Interaction involves cause/effect/consequence for all linked systems. Implicit or explicit cycles; language of argument is readily accessible to students at varying LP levels or explicit statement about different arguments to be used depending on LP level of student(s).

No examples