Summary of the 2011 Curriculum Development Survey
College Ready Curriculum Development
College Ready Staff
January, 2012

Overview

College Ready participants have been encouraged to revise curriculum materials in ways that will better serve their students and be consistent with their instructional resources. To help guide decisions about the revision of curriculum, participants each year have been given the opportunity to survey their students' readiness to learn. These surveys have addressed student beliefs about the nature of knowledge, the nature of science, and their role in learning. Teachers have also been given the opportunity to complete similar surveys that can inform curriculum development by investigating the accuracy of the teacher's perception of student beliefs. Summaries of these comparisons are provided here for all courses for which both *College Ready* teachers and their students responded to the survey.

Student and Teacher Data

For twenty-two classes with a total of 405 students a comparison of the responses of each teacher with their students is provided in this report. Each participating teacher was asked to use a numeric code generated at the beginning of the teacher survey to identify their students. For these twenty-two classes a code was used. Additional responses were provided by classes in which no identifying code was used. An analysis of the overall population is provided for comparison with each participating class for each of three types of data:

- Student-learner characteristics
- Teacher and student expectations for the goals of the course
- Student beliefs about the nature of science and how people learn

Survey questions are presented in Appendix A.

Student-Learner Characteristics

Certain learner characteristics enable learning. Five dimensions were examined: 1) interest in learning and willingness to accept challenges, 2) ability to self-regulate learning, 3) perceived role in learning, 4) belief that concepts should be simple, and 5) belief that learning should occur quickly. Following Elby and Hammer (2001) responses were interpreted as either productive or non-productive rather than correct or incorrect. These survey items were derived from the work of Schunk (1996), Schommer (1994), Bandura (1977), Locke and Latham (2002) and Hofer and Pintrich (1997). A more complete description of these survey items and the relevant research literature is available in the Spring 2010 report to the *College Ready* participants. Readiness to learn, as measured by these indices, can guide the revision of curriculum materials.

Teacher and Student Expectation for the Learning Goals

Responses rate the expectation that reasoning skills in Bloom's hierarchy should be supported by the course. These items were taken from the *High School Survey of Student Engagement* (Zapf, 2006). An additional reasoning skill of experimental design was added. Degree of congruence between students and teacher of what is appropriate and an awareness of the aspirations of students can inform curriculum decisions.

Student Beliefs About the Nature of Science and How People Learn

These questions related to nature of science and the role of a learner. Following Gray (2008), in addition to the student's self-report of their beliefs, they were asked to predict the beliefs of an expert. Teachers were asked to predict student beliefs.

Responses to these items can be interpreted in terms of Vygotsky's (1976) concept of the zone of proximal development as the progression from current understanding to what we know and can do with the assistance of others. With help from a teacher a concept is mastered and the boundary of the zone of proximal development advances. Effective lessons have a scale of length that is consistent with the distance between what is known today and what may be known tomorrow. This distance is viewed differently by students and teachers. One perspective is a blurry self-reflection; the student has beliefs about their capacity to learn and how learning occurs. These may be inaccurate and non-productive, but have been shaped by their experiences. The learner's perspective may not be informed by external assessment and they might not have developed the ability to self-assess. From a second perspective the student looks outward as if from within a refractive bubble. They have beliefs about what it is to know and about the feasibility and effort of acquiring expert understanding. Student actions and thoughts are guided by both of these visions. Data in this section are interpreted in terms of the student's prediction of expert beliefs as a productive or non-productive learning objective. As observed in Gray et al (2008) students consistently predict the expert to have more productive beliefs than their own.

In contrast, the perspective of the teacher looks inward through this bubble. The inner boundary of the zone of proximal development is defined by what the student currently knows and can do. Surface features of that knowledge such as the ability to reproduce facts or implement algorithms are more easily measured than other skills involving reasoning or the design of strategies. Assessment of deeper features may not frequently occur during instruction. And the teacher may not be well informed about the perspective of the student. In fact, we find that teachers consistently predict less productive beliefs than those reported by the students.

Revisions of curriculum materials and lesson plans to target the higher-order skills expected by both teachers and students should be guided by what the student thinks about the nature of science and their role in learning. Awareness of the fact that students demonstrate the ability to predict expert perspectives that are more productive than their own provides a "Vygotsky lever" that can be used to facilitate learning.

The Kinds of Questions These Data Can Inform

Several patterns emerge in these data. The National Academy Committee on Developments in the Science of Learning (Bransford, 2000) summarized progress made in understanding how people learn and how transformative modifications of learning environments can support learning. A summary analysis of patterns shown in the data is provided in terms of recommendations made in *How People Learn (HPL).* Where one of these features is present in a class report, a teacher might consider these recommendations as they go about their daily task of revising and realigning the curriculum materials and lesson plans for their classes.

These trends are observed in the data and are grouped into three clusters:

Cluster of trends related to scientific reasoning and the nature of science

- Students tend to approach science as a set of formulas and facts that are to be memorized (Q1 and Q5).
- Teachers underestimate student beliefs in the importance of memorization (Q1 and Q5).
- Teachers intend for memorization to receive the least emphasis within the Bloom hierarchy (Q25-Q31).
- Teachers believe that the entire spectrum of reasoning in Bloom's taxonomy (including experimental design as an additional reasoning skill) should receive emphasis in the course (Q25-Q31) and students tend to agree.

Cluster of trends related to motivation, learning strategies, and self-regulation

- Students tend to regard their role as passive recipients of knowledge (Q3, Q10, Q11, Q16, and Q18) and teachers tend to agree.
- There is a broad distribution among students in the development of effective learning strategies such as questioning, restating, and focused attention and subpopulations are suggested by the data (Q9, Q14, and Q20).
- Subpopulations are suggested where the desire to learn and to be challenged are assessed (Q13 and Q17).
- Students tend to regard knowledge as simple, prefer step-by-step procedures, dislike ambiguity, and tend to believe that teachers make concepts more complex than they really are (Q15, Q19, and Q22)
- Students are aware that knowledge does not necessarily come quickly and that the ability to learn can be acquired (Q12, Q21, and Q24).

Cluster of trends related to robustness and transferability of knowledge

- Students believe that they understand the steps in laboratory experiments or solution strategies and teachers are consistently unaware of their confidence (Q4 and Q7).
- Students tend to believe that there is a single correct approach to the solution of a problem, but predict that experts have multiple paths (Q2). However, they also tend to believe that if two different approaches are taken you arrive at two different answers that are both correct. (Q6).
- In an earlier survey of *College Ready* students it was observed that students do not believe it is possible to transfer approaches to distant problems. The belief was so dominant that the item was removed from subsequent surveys.
- Students are aware that their approach to learning differs from that of the expert (Q1, Q3, Q5, Q6 and Q8).
- Students tend to regard knowledge as simple, prefer step-by-step procedures, dislike ambiguity, and tend to believe that teachers make concepts more complex than they really are (Q15, Q19, and Q22)
- Students are aware that knowledge does not necessarily come quickly and that the ability to learn can be acquired (Q12, Q21, and Q24).

Curriculum and Assessment Recommendations From *How People Learn*
Below each of the six recommendations on curriculum (CR) and assessment (AR) from *How People Learn*, strategies are suggested to help achieve those recommendations. These strategies combine ideas from HPL with other research summaries from the National Research Council (Olson, 2000; Singer, 2005). In the next section an analysis of the survey data is provided and these strategies are then identified as possible interventions.

CR.1. Curriculum must scaffold learning from preexisting understandings that their students bring with them.

Curriculum Strategy 1: Instruction can reflect the inquiry process of science in that it can be sequenced in a learning cycle where through questions and a discussion, students express their representation of a phenomenon without the use of privileged language, test their representation through experience, and continuously assess progress.
Curriculum Strategy 2: Instruction can identify what is assumed to be understood presently, provide goals for learning for the student of what constitutes understanding for the student, and look further forward to connect these to expert understanding.

CR.2. Curriculum must support the learning of some content and skills in depth while also supporting a foundation of factual knowledge.

Curriculum Strategy 3: Instruction can provide explicit goals for learning beyond declarative knowledge including applications, explanations, predictions, mathematical reasoning, and the design of strategies and experimental procedures.
Curriculum Strategy 4: Instruction can provide clear scope for appropriate factual knowledge with explicit learning objectives that make clear what is and is not expected of the student.

CR.3. Interaction with curriculum must allow students to participate actively in their learning, thinking about their thinking, developing strategies to solve problems, organizing knowledge into a conceptual framework, and asking and pursuing their own questions.

Curriculum Strategy 5: Curriculum can integrate multiple modes of instruction including lecture, demonstration, simulation, problem-solving, teacher-directed and student-directed experimentation, and collaboration among students.

Assessment Recommendations

AR.1. Assessments must uncover preexisting understandings of content, skills, as well as their perceptions of the nature of knowledge and their role the acquisition of knowledge.

Assessment Strategy 1: Formative assessment can guide instructional decisions.
Assessment Strategy 2: Items can scaffold the use of unfamiliar language and contexts with supporting prompts.

AR.2. Assessments must be aligned with the purposes of instruction and support growth in both knowledge and skill development.

Assessment Strategy 3: Items can explicitly map to instructional goals and target both content and skills, even when high-stakes testing only targets the former.
Assessment Strategy 4: Variety in assessment instruments can be used to differentiate instruction.

AR.3. Assessment rubrics must value reasoning and reflection.

Assessment Strategy 5: Rubrics can deemphasize correct-answer responses and emphasize solution paths.
Assessment Strategy 6: Single sheets of notes can be permitted in assessment with a two-column format in which a formula is expressed mathematically and in words.
Assessment Strategy 7: Assessment can be made of non-declarative knowledge.

Analysis of Data Trends
The three categories of trends observed in the survey data are examined separately. The trends are first identified. Possible interpretations are then made in terms of results in sections 1 and 3 of the report. Then possible modifications of curriculum materials, instructional practices, and assessment methods are identified in terms of the recommendations found in *How People Learn*.

Cluster of trends related to scientific reasoning and the nature of science
- Students tend to approach science as a set of formulas and facts that are to be memorized (Q1 and Q5).
- Teachers underestimate student beliefs in the importance of memorization (Q1 and Q5).
- Teachers intend for memorization to receive the least emphasis within the Bloom hierarchy (Q25).
- Most teachers believe that the entire spectrum of reasoning in Bloom's taxonomy (including experimental design as an additional reasoning skill) should receive emphasis in the course (Q25-Q31) and students tend to agree.

Possible Interpretations of the data
Teacher and students are generally aligned on the importance of declarative knowledge in the class. It's not surprising to observe that teachers under-predict the student perception of the difficulty of memorization. The data suggests the possibility that students and teachers interpret the nouns "memorization" and "understanding" differently. There is not a strong correlation between student responses to Q1 and Q5 where the interpretation of these words will influence the response. Students may perceive learning to be measured by performance on assessments, where memorization is rewarded. However, students' informal and personal experiences may broaden their interpretation so that they interpret memorization and understanding to be different. The teacher may anticipate that learning and understanding will be interpreted by the student more narrowly and so miss an opportunity to take advantage of this discrimination by the student.

Survey item Q1 might be interpreted by the student to mean the memorization of formulas, rules and steps in an algorithm. It might also mean the ability to use language. Science instruction may be jargon-laden and assign unfamiliar meanings to familiar terms such as object, inertia, momentum, energy, force and elastic: "the inertia of the larger object imparted greater momentum and during the collision some energy was lost and so the event was inelastic." Challenges here are similar to those involved in language instruction.

Some learning environments provide an advantage to students who are able to memorize but not necessarily apply a fact. To remove this bias one may explicitly state the learning objectives, including the scope of factual information, and include the entire hierarchy of reasoning skills identified by both teachers and students in this survey as valuable. This will raise the bar for all, particularly those who have in the past relied upon memorization to succeed.

Vygotsky levers that may be revealed by the results in section 3 of the report
- When the students' perception of the expert lies to the right of their own, students may respond to models of active, metacognitive learning (*HPL*, p. 28) and may respond to models of principle-based organization of phenomena (*HPL*, p. 36).
- When the teacher prediction lies to the left of the student belief and it is found through discussion or other assessments that students do discriminate between replication and understanding, their experiences of knowledge acquisition outside of the classroom might provide an effective model (*HPL*, p. 147).
- When the students' perception of the expert for Q1 and Q5 lies to the left of their own, a more accurate picture of how experts acquire new knowledge is needed.

Instructional strategies that may be indicated by the results in section 1 of the report
- If unusually high frequencies of non-productive beliefs that knowledge should be simple are present then this cohort of students may, possibly due to past instructional practices, perceive knowledge as declarative. Models of expert performance might be needed. Frequent problem solving in familiar contexts, such as puzzles, or the development of new skills, such as recognition of patterns in unfamiliar images could models of knowledge that are valued.
- If there are unusually high frequencies of non-productive beliefs that knowledge should be acquired quickly and if the distribution is narrow then this cohort of students may not yet have been challenged. If the distribution is broad then differentiated instruction could make use of problem solving in heterogeneous groupings to provide models of successful effort.

Suggested modifications of assessments

- rubrics should de-emphasize correct-answer responses and emphasize solution path (Assessment Strategy 1)
- questions should be stripped of language that requires interpretation unless the item targets translation (Assessment Strategy 2)
- permit single sheets of notes in assessment with a two-column format in which a formula is expressed mathematically and in words (Assessment Strategy 5)
- provide alternative methods of demonstrating competency in the learning objectives such as presentations, journaling, or laboratory assessments (Assessment Strategy 4)

Suggested modification of curriculum materials and classroom practices

- an engagement phase should be used in a learning cycle in which models of the phenomenon are expressed by the learner and the teacher without the use of privileged language (Curriculum Strategy 1)
- whole class discussions should attempt to reveal what understanding "looks like" to both the learner and the expert (Curriculum Strategy 2)
- language acquisition occurs through use rather than through explicit instruction and students benefit from opportunities to speak as well as listen (Curriculum Strategy 2)
- make expectations of factual knowledge explicit and limit the scope to what is truly essential (Curriculum Strategy 4)

Cluster of trends related to motivation, learning strategies, and self-regulation

- Students tend to regard their role as passive recipients of knowledge (Q3, Q10, Q11, Q16, and Q18) and teachers tend to agree.
- There is a broad distribution among students in the development of effective learning strategies such as questioning, restating, and sustained, focused attention and subpopulations are suggested by the data (Q9, Q14, and Q20).
- Subpopulations are suggested where the desire to learn and to be challenged are assessed (Q13 and Q17).
- Students tend to regard knowledge as simple, prefer step-by-step procedures, dislike ambiguity, and tend to believe that teachers make concepts more complex than they really are (Q15, Q19, and Q22)
- Students are aware that knowledge does not necessarily come quickly and that the ability to learn can be acquired (Q12, Q21, and Q24).

Possible Interpretations of the data

80% of students surveyed either agreed or strongly agreed that "for a student to learn physics the teacher must explain things well in class." 80% of teachers surveyed predicted that their students would either agree or strongly agree. This item was taken from Gray (2002) who also found a similar confirmation of traditional roles of students and teachers in their survey of university students. Student responses regard experts as less dependent on authority for learning. Responses to other survey items (Q11, Q16, and Q18) showed that students do recognize that they share responsibility. Passive instruction is possibly the only instructional environment that the students have experienced. The transition to an acceptance of personal responsibility for learning is ongoing in 6-12 classrooms. Competition and social norms also make it difficult for students to allow other students to assume an authority role or even to participate in conversation.

Students who develop the ability to think about their thinking and to become self-regulating will flourish and these habits must be encouraged. The teacher who looks will see that much of what they said was not heard; even by those who have the ability to "explain things well in class." The predominance of this belief in the importance of clear exposition from the instructor in this and other studies is a significant barrier to the transformation of science education. Instructional strategies that place increasing responsibility on the student can provide critical support for essential skills that will be needed for success after high school.

Like other reasoning skills, metacognition is a skill whose acquisition can be supported by instructional strategies. For many students effective reflection on what is known and habits of self-regulation are only just beginning to emerge as academic challenge increases. Although a transition to student-directed inquiry in science class is in part intended to engage students in more authentic practices of science, a more important purpose is to support the development of self-directed, life-long learning. Student responses indicate a preference for step-by-step guidance and low ambiguity, so the challenge for the teacher is to scaffold this development.

Vygotsky levers that may be revealed by the results in section 3 of the report

- Student responses generally predict that expert performance in problem solving or laboratory work is a reflective, creative process. Students may respond to modeling of that process through thinking aloud, generating alternative solution strategies, analogical thinking and frequently assessing progress (*HPL*, 67). This can be followed by reciprocal teaching in which the student is asked to narrate their thinking as they solve a problem or develop an experimental strategy.

Instructional strategies that may be indicated by the results in section 1 of the report

- If a significant fraction of the class is in the 3rd or 4th quartile in the self-regulation factor, strategies that reward goal-setting and self-assessment behaviors should be implemented. A reflective journal that is periodically assessed can be used to support both. Short-writes in which students pause to summarize their understanding on index cards or in their journal can be used to establish a habit of reflection.
- If a significant fraction of the class is in the 3rd or 4th quartile in the self-efficacy factor, strategies that increase student engagement should be implemented. A learning cycle should begin with observable phenomena that students perceive as relevant to their lives. Reasoning is hard work and enthusiasm for large challenges can be nurtured with praise and other rewards for having accepted and met small challenges.

Suggested modification of curriculum materials and classroom practices:

- use group work and peer instruction (Curriculum Strategy 5)
- use integrated instructional units that mix instructional modes, particularly those which enhance the student's role in the learning (Curriculum Strategy 5)
- model metacognition during strategy development for problem solving and experimental design (Curriculum Strategy 1)
- make process skills explicit learning objectives (Curriculum Strategy 3)

Suggested modifications of assessments

- assess student practices involving reflection, self-assessment and strategy development (Assessment Strategy 7)
- utilize a variety of assessment tools such as journals and presentations, as well as tests (Assessment Strategy 4)
- alternative strategies are a form of risk-taking that assessment should value (Assessment Strategy 5)

Cluster of trends related to robustness and transferability of knowledge

- Students believe that they understand the steps in laboratory experiments or solution strategies and teachers are consistently unaware of their confidence (Q4 and Q7).
- The students have a more sophisticated view of science and science expertise than the teacher predicts (Q5).
- Students tend to believe that there is a single correct approach to the solution of a problem, but predict that experts have multiple paths (Q2). However, they also tend to believe that if two different approaches are taken you arrive at two different answers that are both correct. (Q6).
- In an earlier survey of *College Ready* students it was observed that students do not believe it is possible to transfer approaches to distant problems. The belief was so dominant that the item was removed from subsequent surveys.
- Students are aware that their approach to learning differs from that of the expert (Q1, Q3, Q5, Q6 and Q8).
- Students tend to regard knowledge as simple, prefer step-by-step procedures, dislike ambiguity, and tend to believe that teachers make concepts more complex than they really are (Q15, Q19, and Q22)
- Students are aware that knowledge does not necessarily come quickly and that the ability to learn can be acquired (Q12, Q21, and Q24).

Possible Interpretations of the data

Instruction in earlier courses or in this course prior to the survey may have emphasized a particular solution strategy that is consistent with a context or is most efficient. For example, in the F=ma unit one usually begins with the construction of a free-body diagram, sums the forces, and solves for the acceleration. The predictions of student responses by instructors suggest that they perceive that the student may be limited by this approach. The prediction may also reflect the teachers' experiences that transfer of a strategy between problems is often difficult for students and that students tend to categorize problems according the solution strategy.

Alternatively, it may be that students do not recognize "different approaches." For instance, one may "solve for acceleration" symbolically or graphically. One may even describe the solution in words or pictures. In the cognitive research literature these are distinct representations which the student or teacher may not think of as different approaches. Seeing these approaches as distinct allows the expert to initiate solution strategies with an implicit question, such as "what if we try to make a graph of that?" If these different approaches are identified in instruction as distinct reasoning skills and these reasoning skills are explicitly identified, modeled, and assessed then the student is more likely to have access to the expert's approach to problem solving.

In a classroom in which students believe in "simple knowledge" and that "teachers make things unnecessary complicated" these trends in the data may also be interpreted to mean that students believe that experts can solve problems without the "needless complexity" that the instructor is asking of them. The breadth of the distribution for the "simple knowledge" cluster for a class can suggest that there are likely to be a significant number of students with that perspective. When present, these students are more visible to the teacher who may have them in mind in making their predictions of student beliefs.

Among the strongest trends in these data, and in the survey of *College Ready* students and teachers in earlier years, is the large difference between student responses to questions 4, 7, and 8 and teacher's predictions of student responses to these questions. Students believe that they know the reasons for the steps taken in a laboratory experimental or in the solution of a problem. Teachers consistently predict that students do not believe that they understand these processes. An interpretation suggested by a *College Ready* teacher is that students and teachers interpret the question differently. Students are given a series of steps as a lab procedure provided by the instructor and so they are confident of the sequence. However, the student's prediction of the expert behavior is even more confident of the expert's productive understanding. This suggests that the students' responses are not trivial. This can only be resolved by assessment.

As described above in the interpretation of trends related to self-regulation, the transferability of knowledge is known to be highly dependent on (*HPL*, page 67) metacognition. Students who reason through their understanding of the sequence of steps in a solution to a problem or in a laboratory procedure are much more likely to be able to develop a strategy in the solution of an unfamiliar problem or in the design of a new experiment. Since knowledge that cannot be transferred is of little value, this gap between students' and teachers' responses on questions 4, 7, and 8 is of great significance. In earlier surveys students and teachers were asked to consider the statement, "If I want to apply a method used for solving one physics problem to another problem, the problems must involve very similar situations." Roughly two-thirds of *College Ready* students agreed with this statement. Yet three-quarters of the students agree with the statement, "When I carry out a sequence of steps in solving a physics problem or doing an experiment, I know the reason that each step is used." If assessment reveals that students do, in fact, understand these strategies, then an opportunity for students to practice transfer is provided.

Vygotsky levers that may be revealed by the results in section 3 of the report

- A significant "Vygotsky lever" is observed where the student acknowledges that expert knowledge is more flexible than their own (Q2).
- As discussed in the interpretation, teacher under-prediction on each of the items that are claims about science process skills are in marked contrast to student predictions about the expert (Q4, Q7, and Q8) and this suggests needed changes in curriculum and assessment.

Instructional strategies that may be indicated by the results in section 1 of the report

- Where a significant number of students are in the 3rd or 4th quartile of the simple knowledge index, scaffolding is needed in order for students to accept an active role in strategy development or experimental design.
- Where a significant number of students are in the 3rd or 4th quartile of the self-regulation index, curriculum and assessment modifications are needed to guide students toward reflective participation.

Suggested modifications of assessments:

- multiple solution paths can be illustrated with assessment items that ask the student to critique the solution strategy used by a third person who may be either a student (find the flaw in their reasoning) or an expert (what approach was suggested by the analogy?) (Assessment Strategy 4)
- knowledge of the purposes of a laboratory experiment or solution strategy can be identified as learning objectives (Assessment Strategy 3)
- assessment items can ask students to explain the purpose of a step in a solution sequence or laboratory procedure (Assessment Strategy 7)

• reflections in journals can be used for assessment to support metacognition (Assessment Strategies 4 and 5)
• formative assessments rather than summative assessments can be used to close the gap between teacher and student perceptions on questions 4, 7, and 8 (Assessment Strategy 1)
• be aware, through formative assessment, of student conceptions that new approaches are needlessly complex (Assessment Strategy 1)

Suggested modification of classroom practices:
• identify and integrate earlier concepts in new contexts as the learning sequence progresses (Curriculum Strategy 2)
• multiple representations (mathematical, graphical/pictorial and written) should be used at every opportunity (Curriculum Strategy 3) and identified as such (Assessment Strategy 2)
• very efficient solution strategies should be portrayed as flexible heuristics that should be tried first because they are likely to be successful rather than because that are unique (Curriculum Strategy 1)
• take time for open-ended scenarios which can be approached by modifying a recent solution strategy or lab procedure to fit the new context (Curriculum Strategy 5)
• case studies can illustrate analogical solutions in problem solving (Curriculum Strategy 5)

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Appendix A. Survey Questions

Nature of Science Cluster
Q1. A significant problem in learning physics is being able to memorize all the information I need to know.
Q2. There is usually only one correct approach to solving a physics problem.
Q5. Understanding physics basically means being able to recall something you have read or been shown.
Q6. There could be two different correct values for the answer to a physics problem if I use two different approaches.

Claims of Science Process Skill
Q4. When I carry out a sequence of steps in solving a physics problem or doing an experiment, I know the reason that each step is used.
Q7. In doing a laboratory experiment, if my result is very different from what I had expected, it usually is because I made a mistake.
Q8. In doing a physics problem, if my calculation gives a result very different from what I had expected, I trust the calculation rather than going back through the problem.

Self-Efficacy Cluster
Q13. In my classes it is important for me to learn what is being taught.
Q17. I prefer class work that is challenging so I can learn new things.

Self-Regulation Cluster
Q9. I rarely, if ever, ask myself questions to make sure I know the material I have been studying.
Q14. Usually you can figure out difficult concepts if you eliminate all outside distractions and really concentrate.
Q20. When I study I rarely, if ever, put important ideas into my own words.

Simple Knowledge Cluster
Q15. Teachers make ideas unnecessarily complicated.
Q19. My classes should provide step-by-step procedures so that if you did the procedure correctly each time, your answer would be correct.
Q22. It's a waste of time to work on problems that have no possibility of coming out with a clear-cut and unambiguous answer.

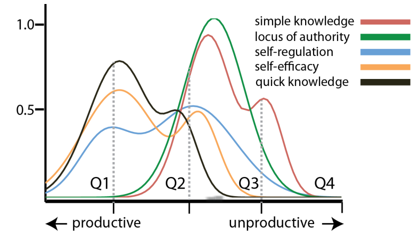
Origin of Knowledge Cluster
Q3. For a student to learn physics the teacher must explain things well in class.
Q11. How much a person gets out of school mostly depends on the quality of the teacher.
Q16. The role of the teacher is to provide clear directions and guidance for all course activities and assignments.
Q18. The teacher should challenge students to present their own ideas and demand evidence that support their ideas.

Quick Knowledge Cluster
Q21. If a person can't understand something within a short amount of time, they should keep on trying.
Q23. Successful students do not always understand things quickly.
Q24. I enjoy problems or tasks in which there may not be a right answer.
Q10. If you are ever going to be able to understand something, it will make sense to you the first time you hear it.
Q12. The ability to learn is something that you are born with.

Expected Learning Objectives
Q25. In science classes I should memorize facts or ideas.
Q26. In science classes I should understand information and its meaning, so that I am able to explain ideas in my own words.
Q27. In science classes I should apply information to new situations or real-world problems.
Q28. In science classes I should analyze the basic parts of an idea or experience.
Q29. In science classes I should organize and combine ideas to form new meanings and relationships.
Q30. In science classes I should make judgments about the value of information or ideas, evaluating whether conclusions are sound.
Q31. In science classes I should design experiments that test my predictions about how things work.

Class ID: 6901 with 33 students reporting 9-12-11 at 11:45 and 14:00

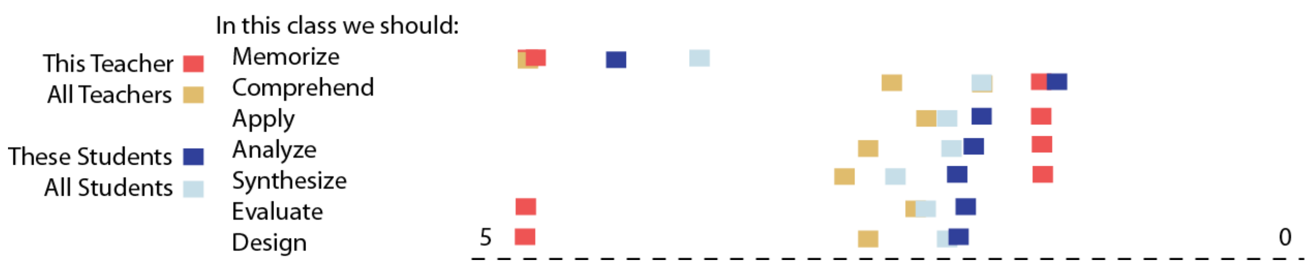
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



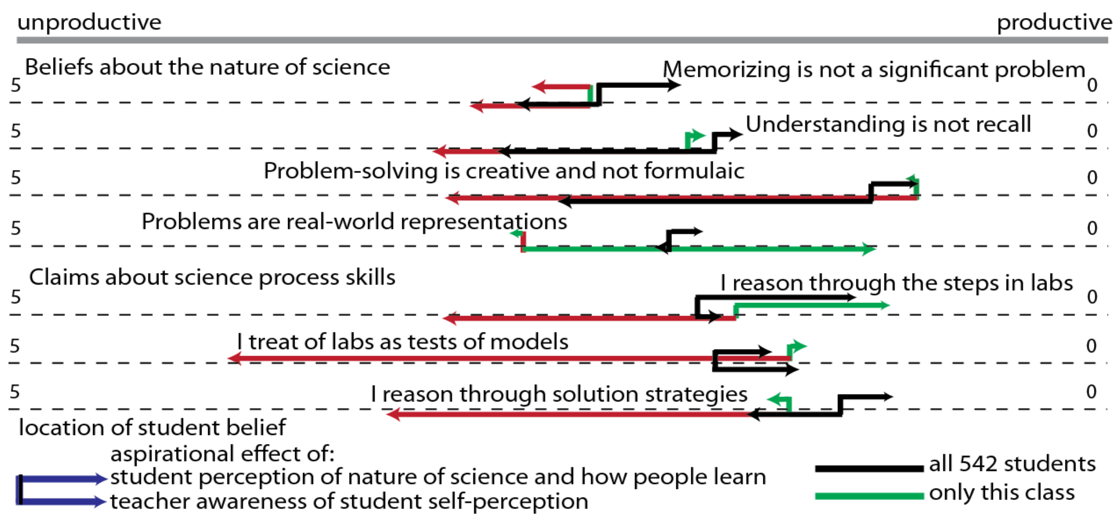
Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	39.4%	34.6%	18.2%	22.1%	0.0%	0.1%	15.2%	37.6%	0.0%	0.0%
Q2	39.4%	43.1%	30.3%	38.8%	45.8%	19.8%	63.6%	53.8%	36.4%	15.2%
Q3	21.2%	22.3%	33.3%	35.9%	48.5%	75.5%	21.2%	8.6%	54.5%	69.2%
Q4	0.0%	0.0%	18.2%	3.2%	6.1%	4.6%	0.0%	0.0%	6.1%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

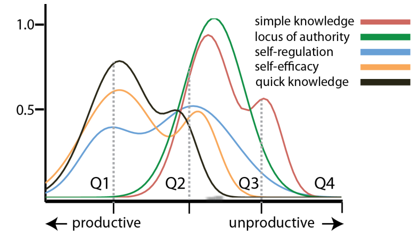


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 28017 with 5 students reporting 9-14-11 at 12:50

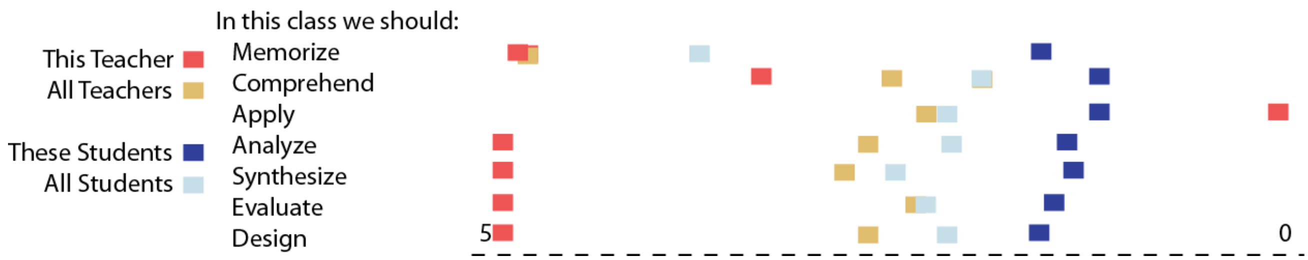
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



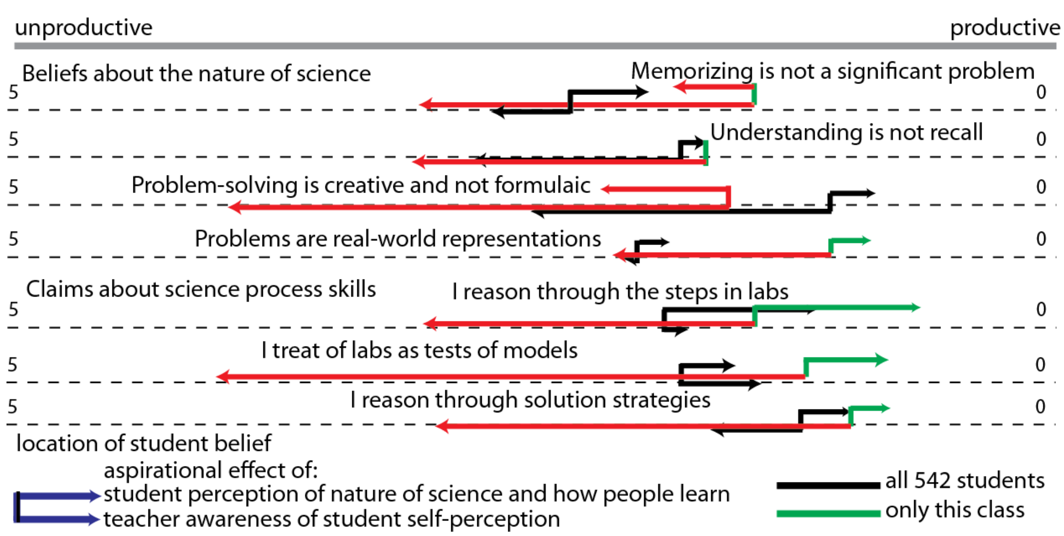
Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	20.0%	34.6%	40.0%	22.1%	0.0%	0.1%	0.0%	37.6%	0.0%	0.0%
Q2	40.0%	43.1%	20.0%	38.8%	60.0%	19.8%	20.0%	53.8%	20.0%	15.2%
Q3	40.0%	22.3%	20.0%	35.9%	20.0%	75.5%	60.0%	8.6%	80.0%	69.2%
Q4	0.0%	0.0%	20.0%	3.2%	20.0%	4.6%	20.0%	0.0%	0.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

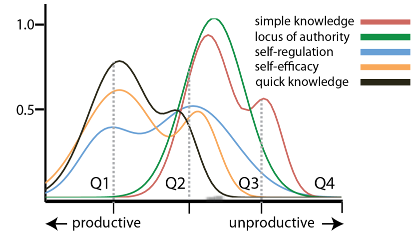


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 35959 with 10 students reporting 9-14-11 at 9:30 and 13:30

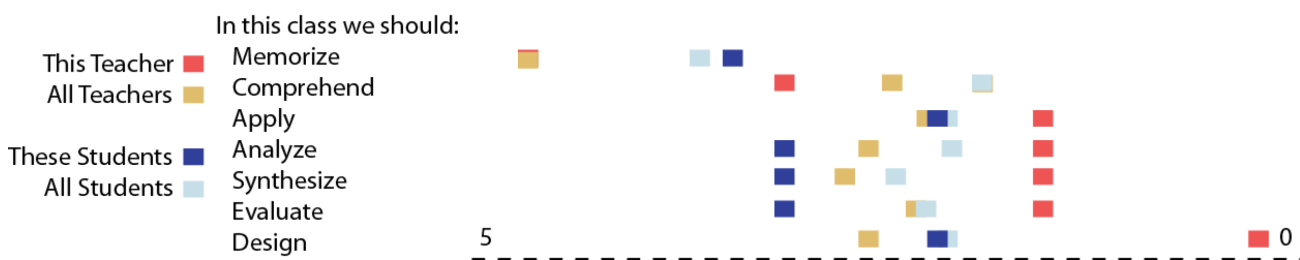
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



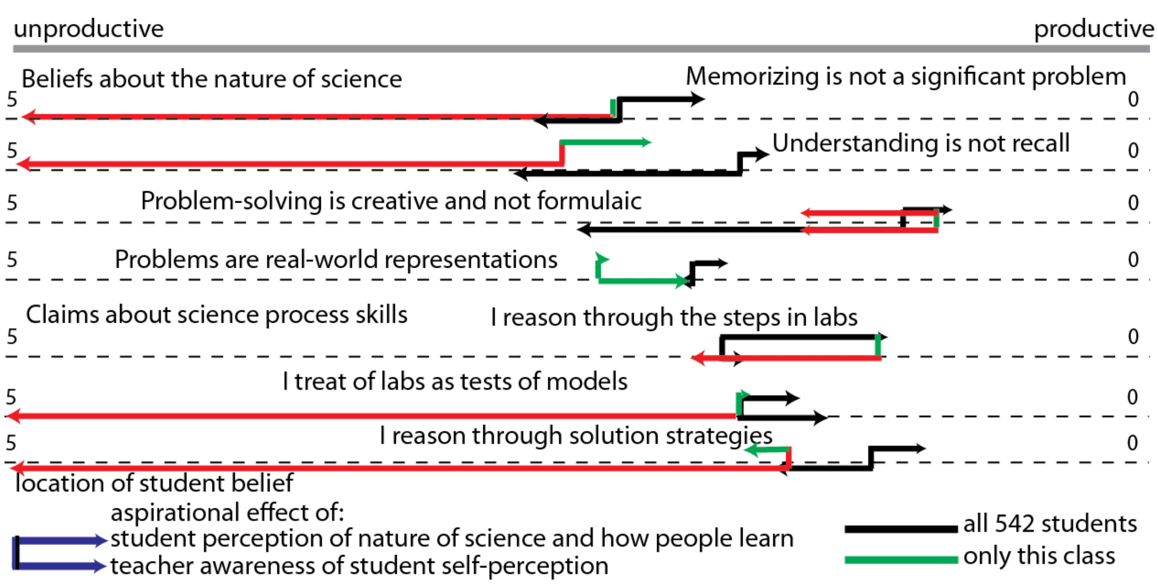
Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	10.0%	34.6%	10.0%	22.1%	0.0%	0.1%	10.0%	37.6%	20.0%	0.0%
Q2	60.0%	43.1%	70.0%	38.8%	20.0%	19.8%	20.0%	53.8%	50.0%	15.2%
Q3	0.0%	22.3%	20.0%	35.9%	50.0%	75.5%	70.0%	8.6%	20.0%	69.2%
Q4	30.0%	0.0%	0.0%	3.2%	30.0%	4.6%	0.0%	0.0%	10.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

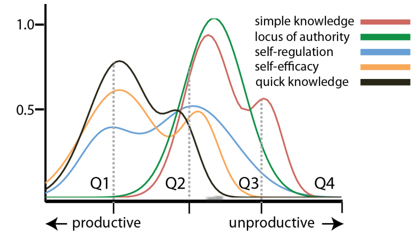


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 198476 with 23 students reporting 9-12-11 at 11:45

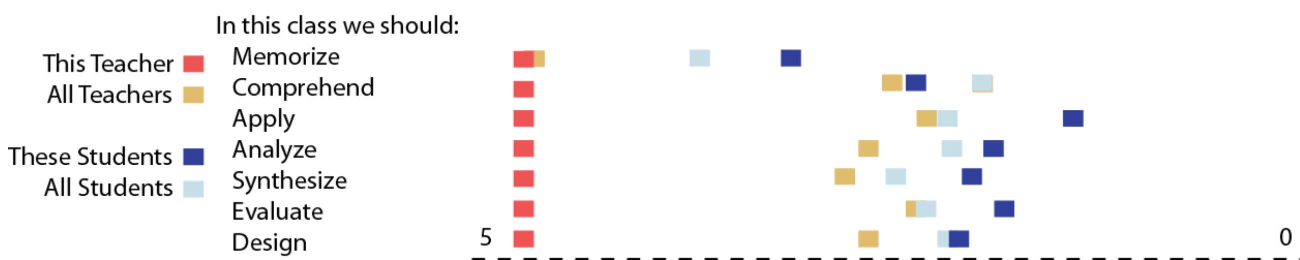
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



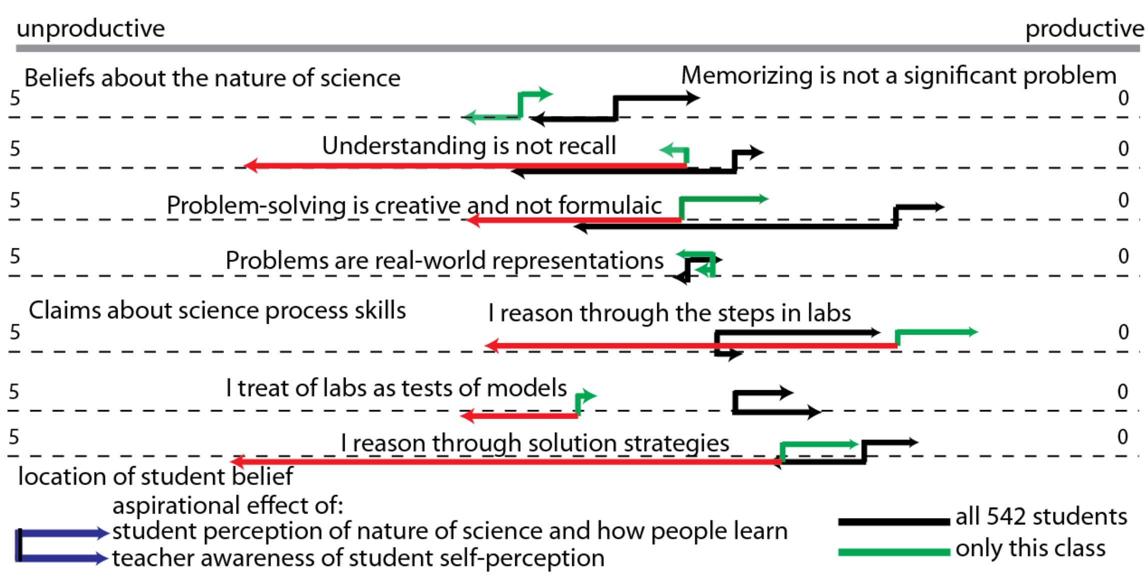
Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	26.1%	34.6%	4.3%	22.1%	8.7%	0.1%	0.0%	37.6%	0.0%	0.0%
Q2	34.8%	43.1%	26.1%	38.8%	47.8%	19.8%	30.4%	53.8%	8.7%	15.2%
Q3	34.8%	22.3%	52.2%	35.9%	39.1%	75.5%	60.9%	8.6%	78.3%	69.2%
Q4	4.3%	0.0%	17.4%	3.2%	4.3%	4.6%	8.7%	0.0%	13.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

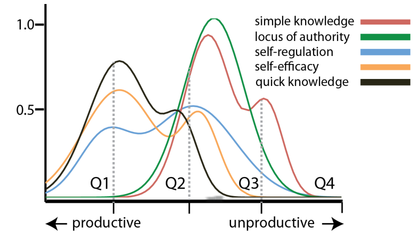


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 296977 with 27 students reporting 9-12-11 at 11:45

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

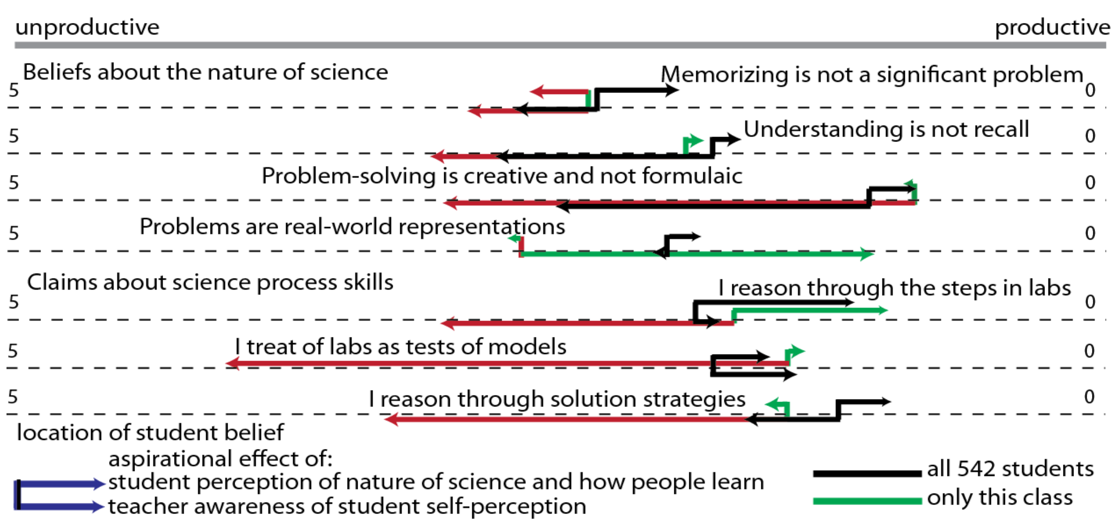


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	29.6%	34.6%	0.0%	22.1%	11.1%	0.1%	0.0%	37.6%	0.0%	0.0%
Q2	44.4%	43.1%	37.0%	38.8%	77.8%	19.8%	44.4%	53.8%	25.9%	15.2%
Q3	25.9%	22.3%	48.1%	35.9%	7.4%	75.5%	48.1%	8.6%	59.3%	69.2%
Q4	0.0%	0.0%	7.4%	3.2%	3.7%	4.6%	7.4%	0.0%	14.8%	15.6%

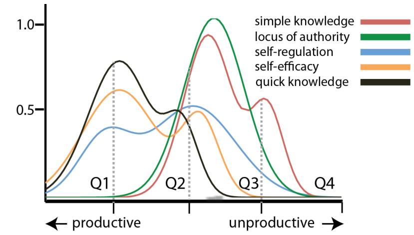
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 432151 with 20 students reporting 9-15-11 at 9:15

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

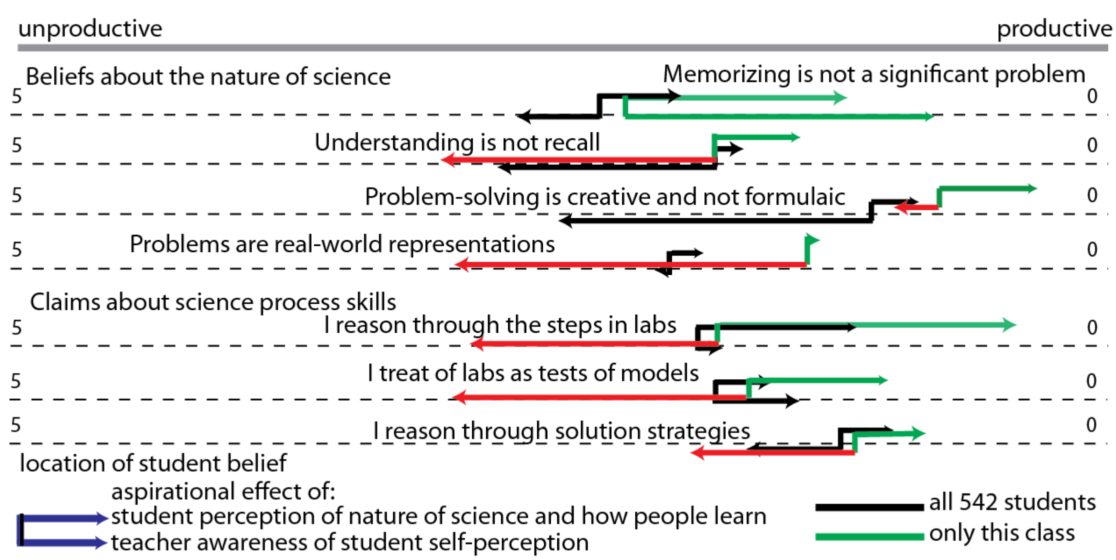


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	25.0%	34.6%	25.0%	22.1%	0.0%	0.1%	10.0%	37.6%	25.0%	0.0%
Q2	60.0%	43.1%	40.0%	38.8%	25.0%	19.8%	50.0%	53.8%	65.0%	15.2%
Q3	10.0%	22.3%	35.0%	35.9%	70.0%	75.5%	40.0%	8.6%	10.0%	69.2%
Q4	5.0%	0.0%	0.0%	3.2%	5.0%	4.6%	0.0%	0.0%	0.0%	15.6%

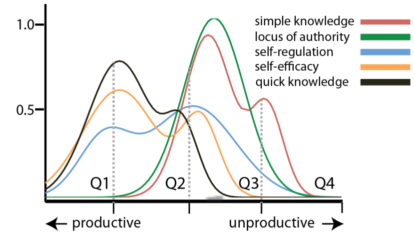
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 431252 with 17 students reporting 9-15-11 at 14:20

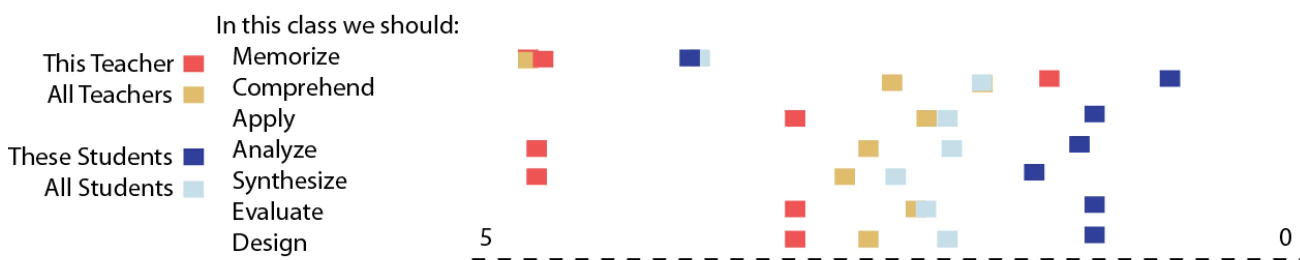
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



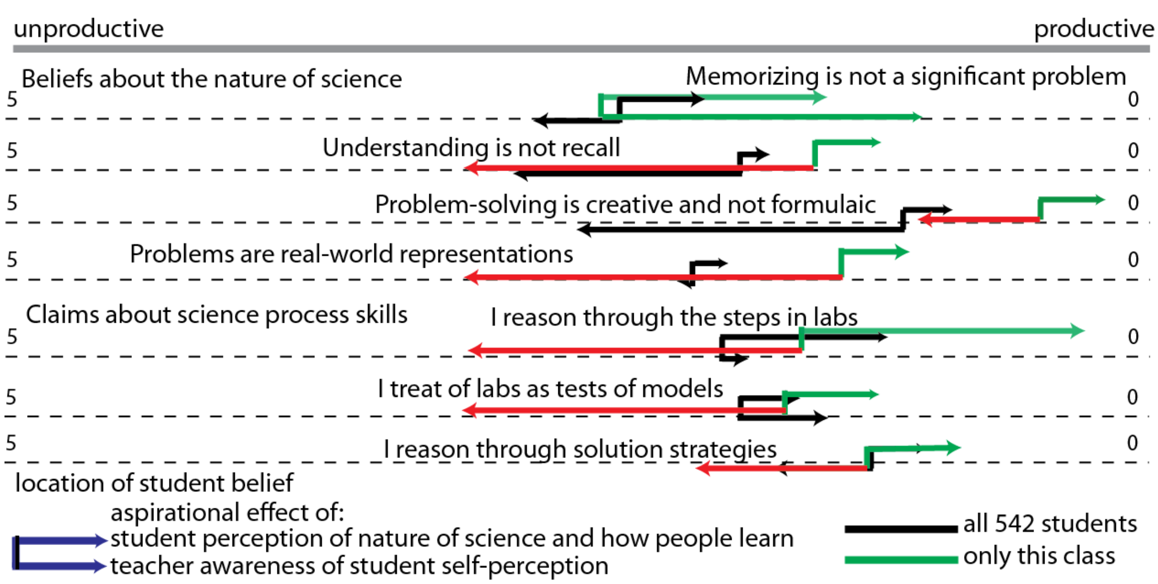
Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	35.3%	34.6%	5.9%	22.1%	0.0%	0.1%	11.8%	37.6%	17.6%	0.0%
Q2	52.9%	43.1%	58.8%	38.8%	41.2%	19.8%	64.7%	53.8%	58.8%	15.2%
Q3	11.8%	22.3%	29.4%	35.9%	52.9%	75.5%	23.5%	8.6%	23.5%	69.2%
Q4	0.0%	0.0%	5.9%	3.2%	5.9%	4.6%	0.0%	0.0%	0.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

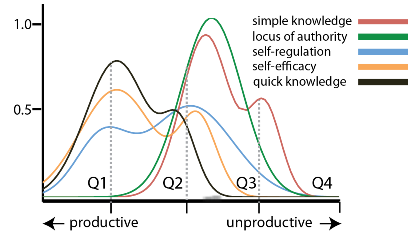


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 432153 with 15 students reporting 9-15-11 at 15:10

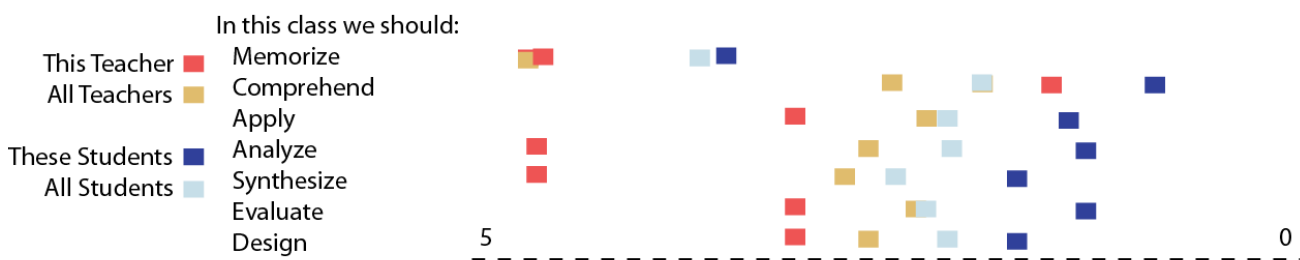
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



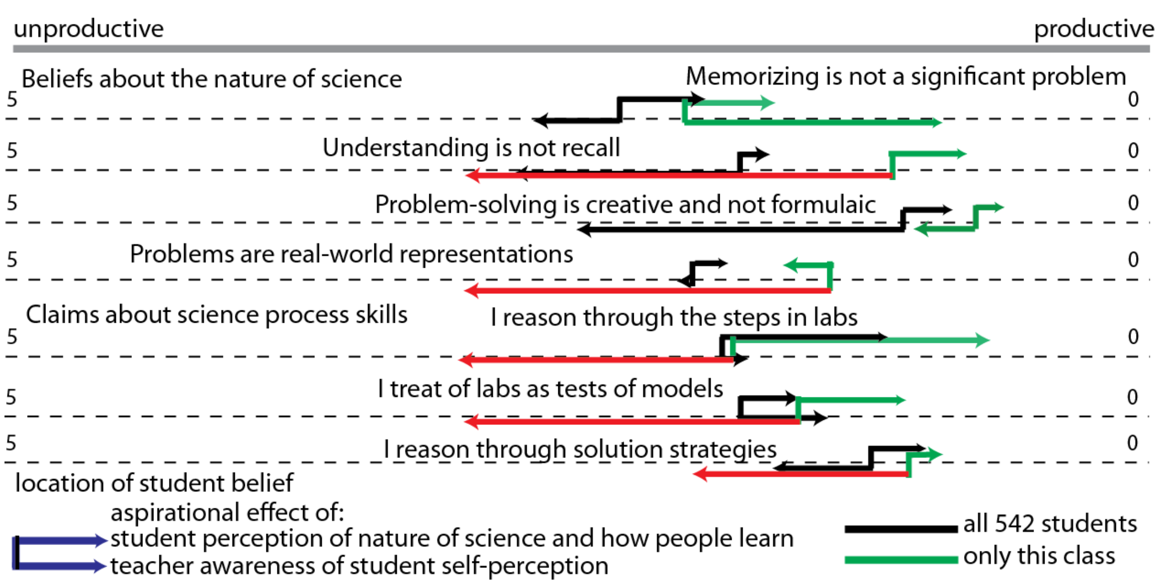
Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	20.0%	34.6%	6.7%	22.1%	0.0%	0.1%	13.3%	37.6%	26.7%	0.0%
Q2	60.0%	43.1%	53.3%	38.8%	46.7%	19.8%	40.0%	53.8%	46.7%	15.2%
Q3	13.3%	22.3%	40.0%	35.9%	46.7%	75.5%	46.7%	8.6%	26.7%	69.2%
Q4	6.7%	0.0%	0.0%	3.2%	6.7%	4.6%	0.0%	0.0%	0.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

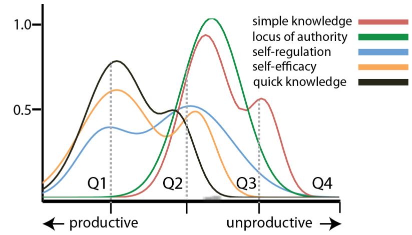


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 525271 with 35 students reporting 9-15-11 at 10:00 and 11:00

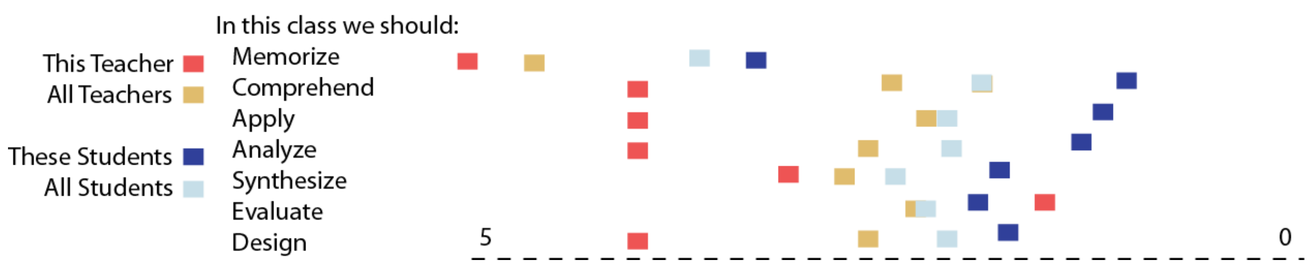
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



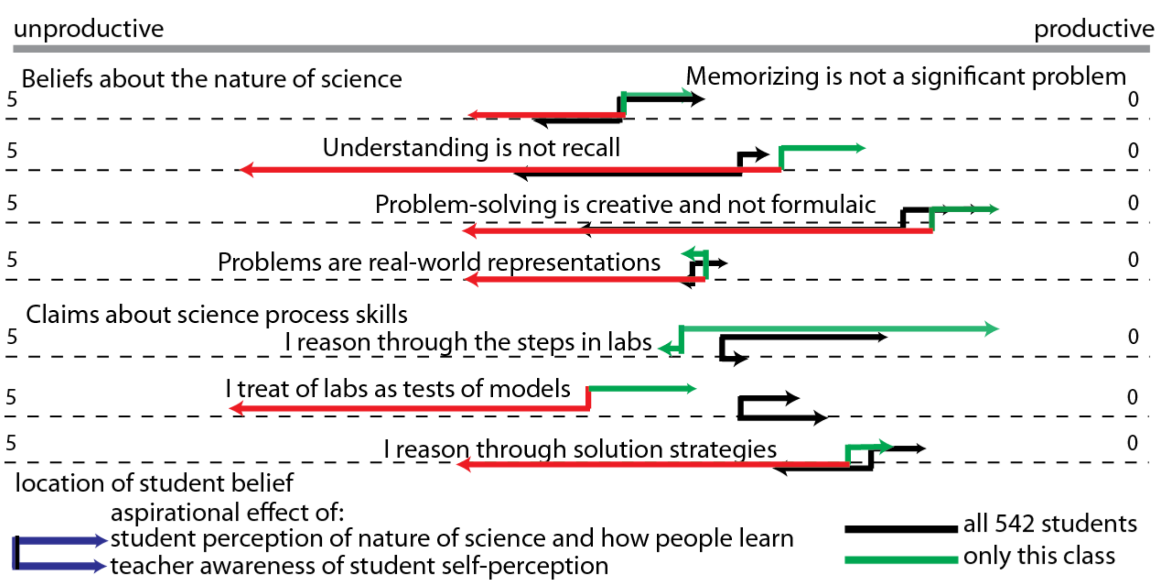
Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	22.9%	34.6%	14.3%	22.1%	0.0%	0.1%	2.9%	37.6%	8.6%	0.0%
Q2	37.1%	43.1%	60.0%	38.8%	45.7%	19.8%	51.4%	53.8%	74.3%	15.2%
Q3	34.3%	22.3%	25.7%	35.9%	45.7%	75.5%	45.7%	8.6%	17.1%	69.2%
Q4	5.7%	0.0%	0.0%	3.2%	8.6%	4.6%	0.0%	0.0%	0.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

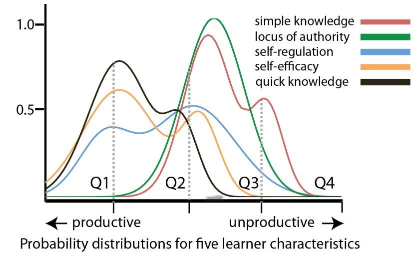


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 525272 with 18 students reporting 9-9-11 at 12:45

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

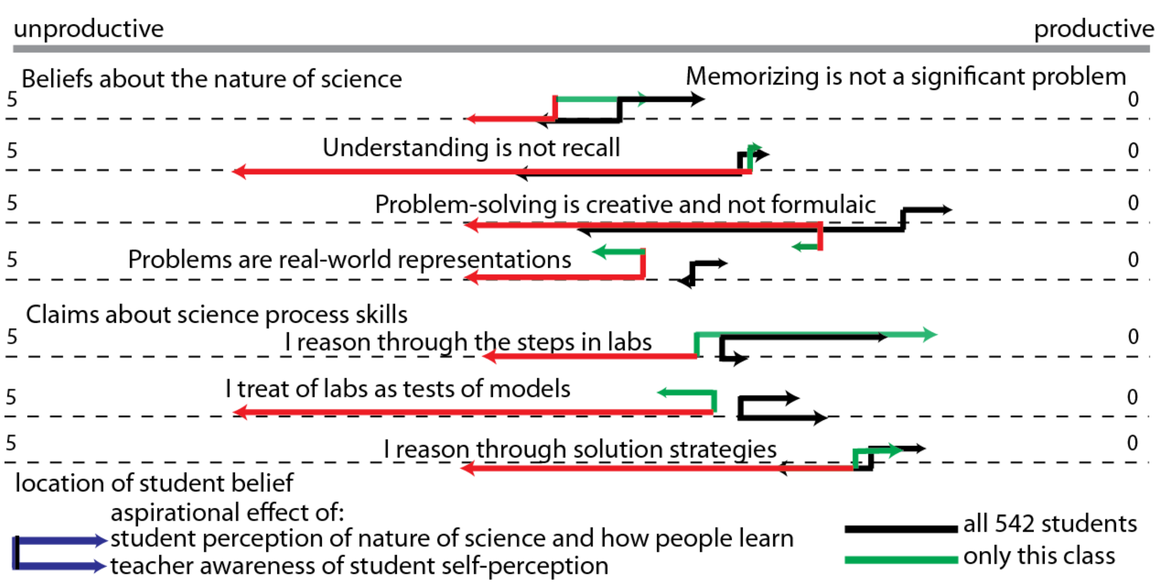


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	5.6%	34.6%	5.6%	22.1%	0.0%	0.1%	0.0%	37.6%	0.0%	0.0%
Q2	50.0%	43.1%	61.1%	38.8%	44.4%	19.8%	50.0%	53.8%	88.9%	15.2%
Q3	38.9%	22.3%	33.3%	35.9%	50.0%	75.5%	44.4%	8.6%	11.1%	69.2%
Q4	5.6%	0.0%	0.0%	3.2%	5.6%	4.6%	5.6%	0.0%	0.0%	15.6%

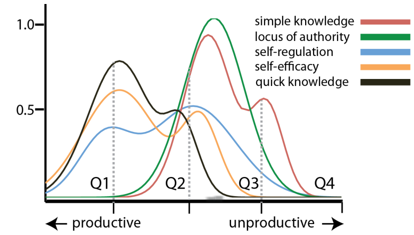
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 525272 with 18 students reporting 9-9-11 at 12:45

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

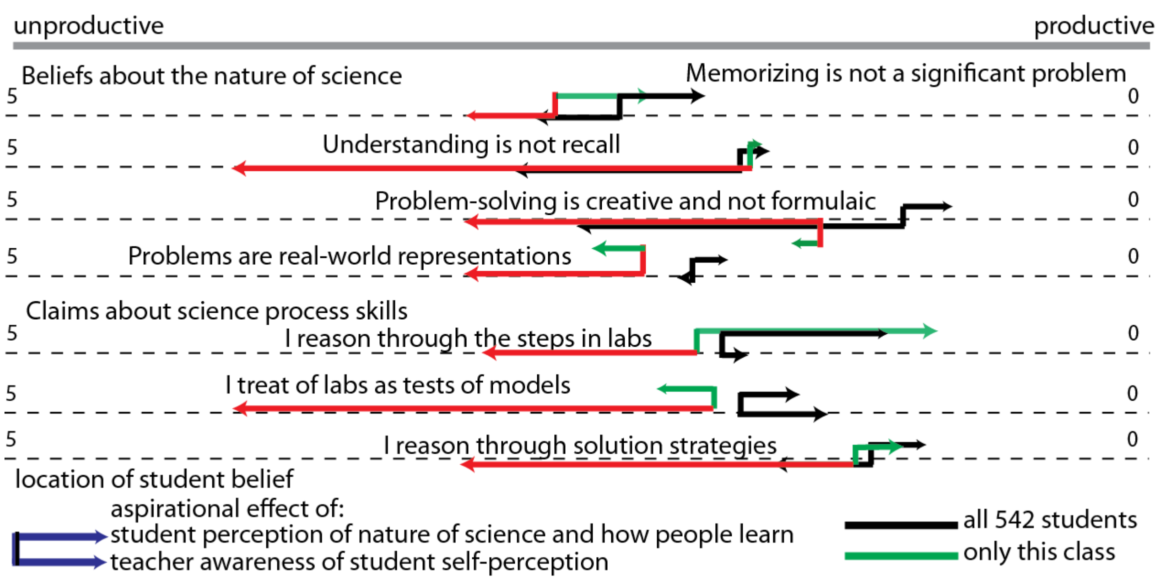


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	5.6%	34.6%	5.6%	22.1%	0.0%	0.1%	0.0%	37.6%	0.0%	0.0%
Q2	50.0%	43.1%	61.1%	38.8%	44.4%	19.8%	50.0%	53.8%	88.9%	15.2%
Q3	38.9%	22.3%	33.3%	35.9%	50.0%	75.5%	44.4%	8.6%	11.1%	69.2%
Q4	5.6%	0.0%	0.0%	3.2%	5.6%	4.6%	5.6%	0.0%	0.0%	15.6%

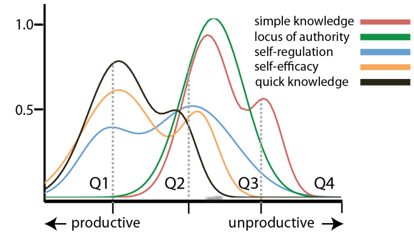
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 525273 with 15 students reporting 9-9-11 at 13:40

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

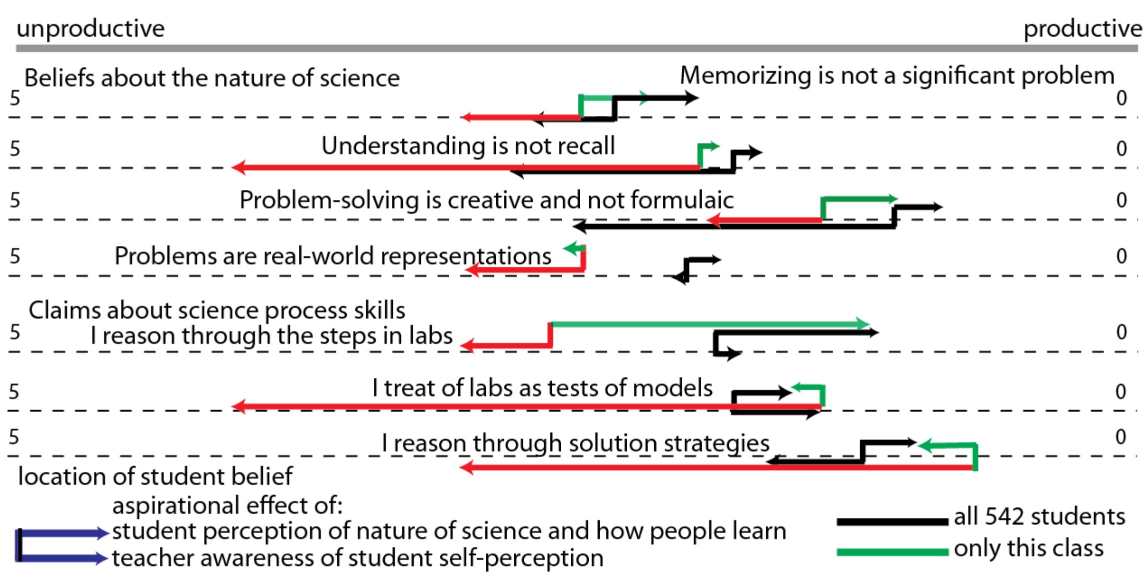


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	13.3%	34.6%	6.7%	22.1%	0.0%	0.1%	6.7%	37.6%	13.3%	0.0%
Q2	53.3%	43.1%	40.0%	38.8%	26.7%	19.8%	26.7%	53.8%	66.7%	15.2%
Q3	33.3%	22.3%	53.3%	35.9%	66.7%	75.5%	66.7%	8.6%	20.0%	69.2%
Q4	0.0%	0.0%	0.0%	3.2%	6.7%	4.6%	0.0%	0.0%	0.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

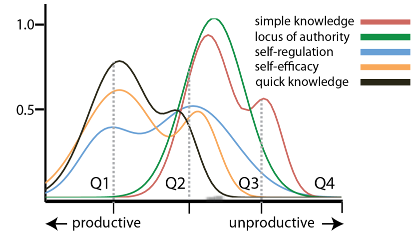
Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 549212 with 11 students reporting 9-11-11 at 13:20

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.

Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

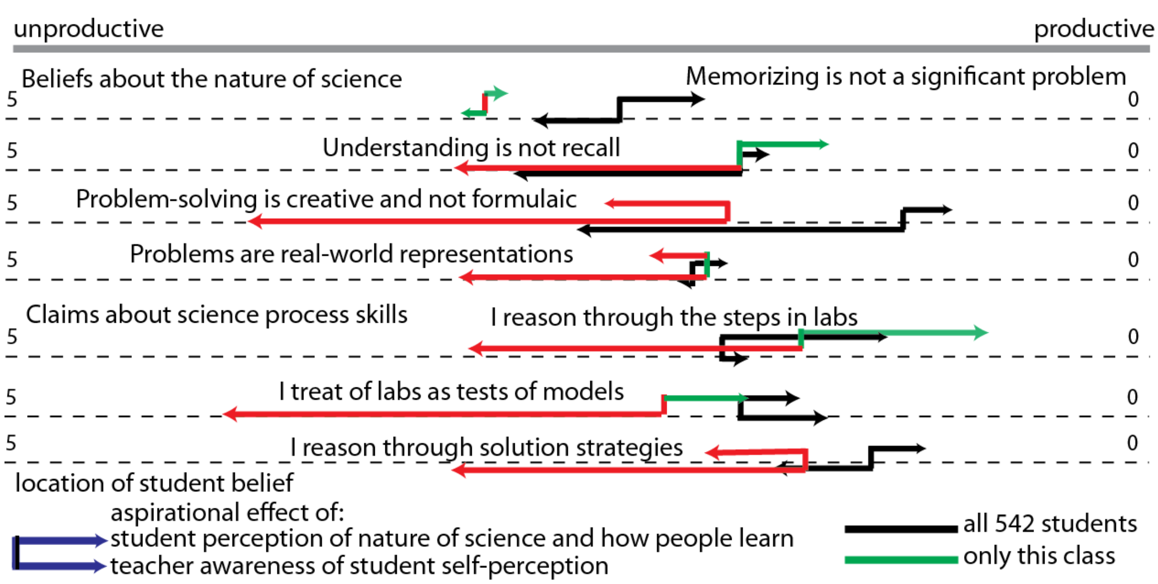


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	18.2%	34.6%	27.3%	22.1%	0.0%	0.1%	0.0%	37.6%	0.0%	0.0%
Q2	45.5%	43.1%	45.5%	38.8%	63.6%	19.8%	45.5%	53.8%	72.7%	15.2%
Q3	18.2%	22.3%	27.3%	35.9%	27.3%	75.5%	45.5%	8.6%	27.3%	69.2%
Q4	18.2%	0.0%	0.0%	3.2%	9.1%	4.6%	9.1%	0.0%	0.0%	15.6%

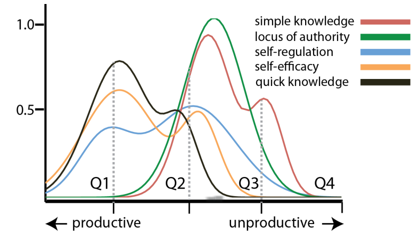
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 635864 with 17 students reporting date and time not known

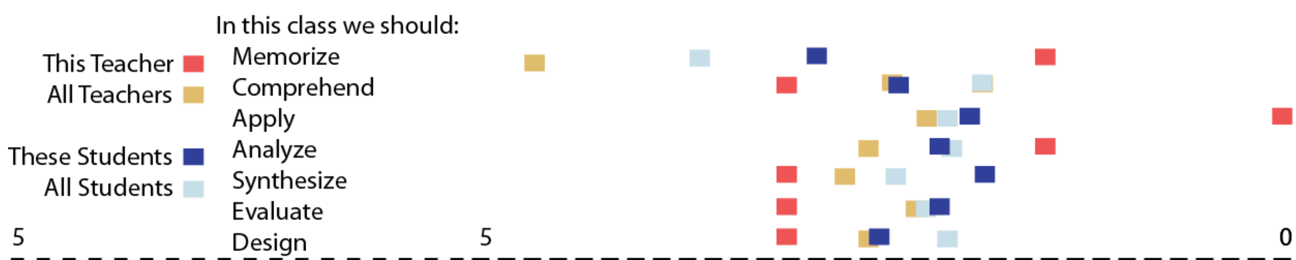
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



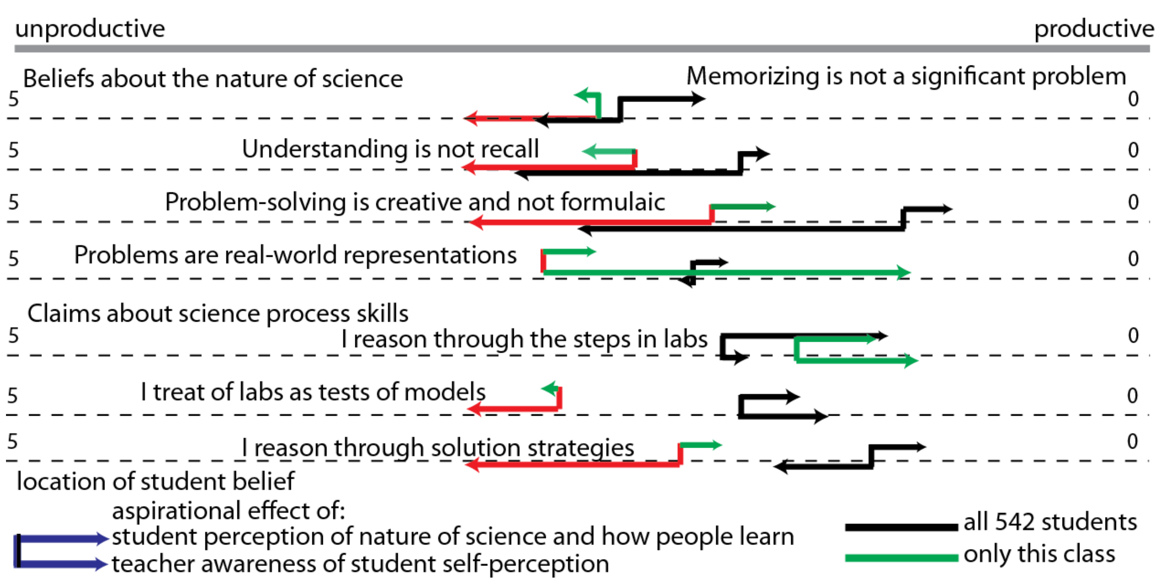
Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	11.8%	34.6%	5.9%	22.1%	11.8%	0.1%	0.0%	37.6%	0.0%	0.0%
Q2	17.6%	43.1%	11.8%	38.8%	58.8%	19.8%	35.3%	53.8%	23.5%	15.2%
Q3	58.8%	22.3%	52.9%	35.9%	29.4%	75.5%	52.9%	8.6%	58.8%	69.2%
Q4	11.8%	0.0%	29.4%	3.2%	0.0%	4.6%	11.8%	0.0%	17.6%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

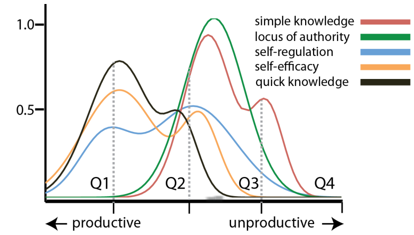


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 760549 with 13 students reporting 9-14-11 at 19:40, 9-15-11 at 10:45 and 9-15-11 at 22:30

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

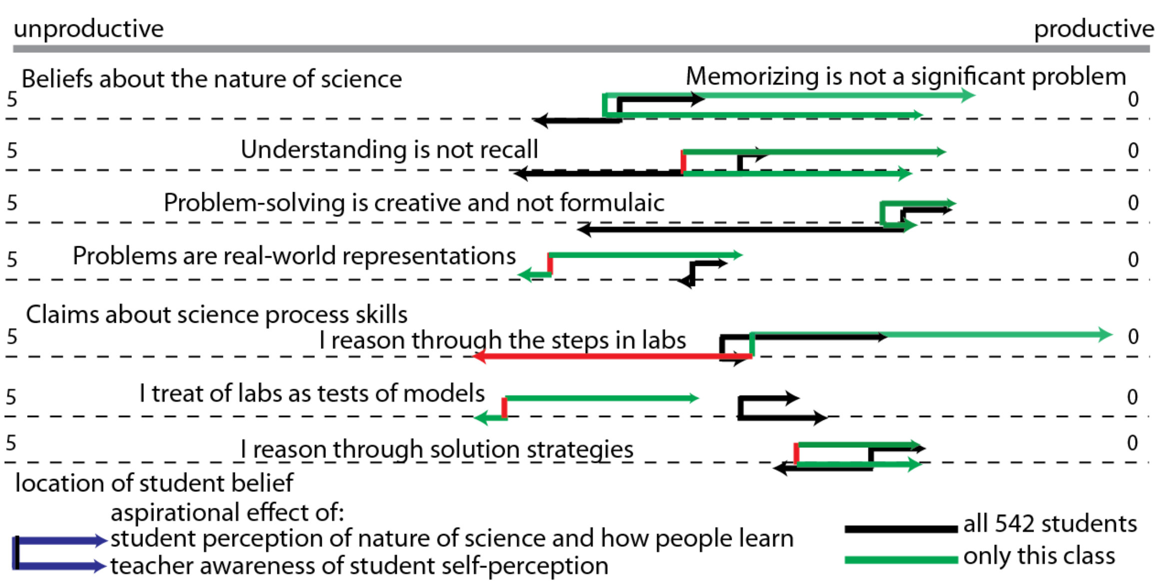


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	23.1%	34.6%	15.4%	22.1%	0.0%	0.1%	7.7%	37.6%	23.1%	0.0%
Q2	46.2%	43.1%	46.2%	38.8%	23.1%	19.8%	46.2%	53.8%	30.8%	15.2%
Q3	7.7%	22.3%	38.5%	35.9%	61.5%	75.5%	38.5%	8.6%	46.2%	69.2%
Q4	23.1%	0.0%	0.0%	3.2%	15.4%	4.6%	7.7%	0.0%	0.0%	15.6%

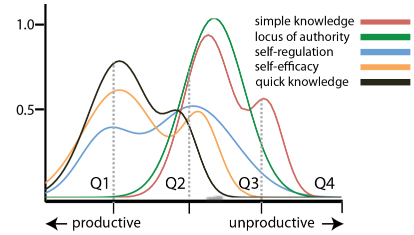
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 997175 with 15 students reporting 9-8-11 at 14:00

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

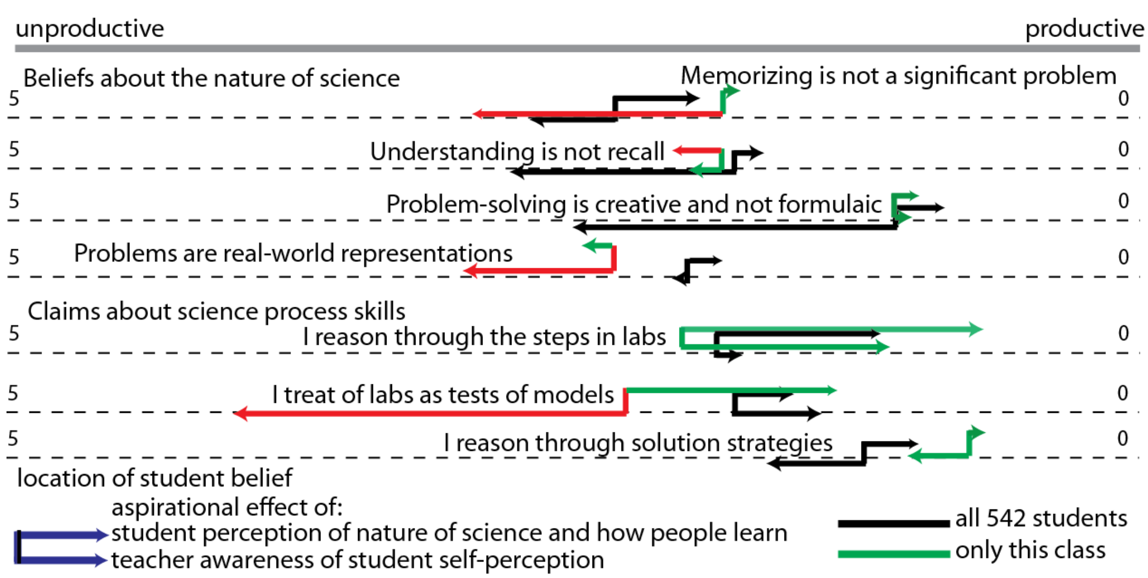


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	20.0%	34.6%	40.0%	22.1%	0.0%	0.1%	6.7%	37.6%	20.0%	0.0%
Q2	53.3%	43.1%	40.0%	38.8%	73.3%	19.8%	60.0%	53.8%	53.3%	15.2%
Q3	26.7%	22.3%	20.0%	35.9%	26.7%	75.5%	26.7%	8.6%	26.7%	69.2%
Q4	0.0%	0.0%	0.0%	3.2%	0.0%	4.6%	6.7%	0.0%	0.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

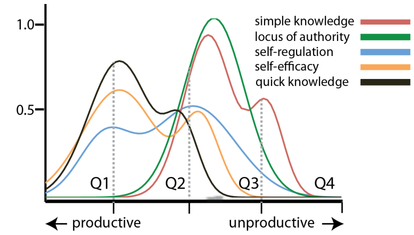
Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 2357841 with 11 students reporting 9-9-11 at 8:30

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.

Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

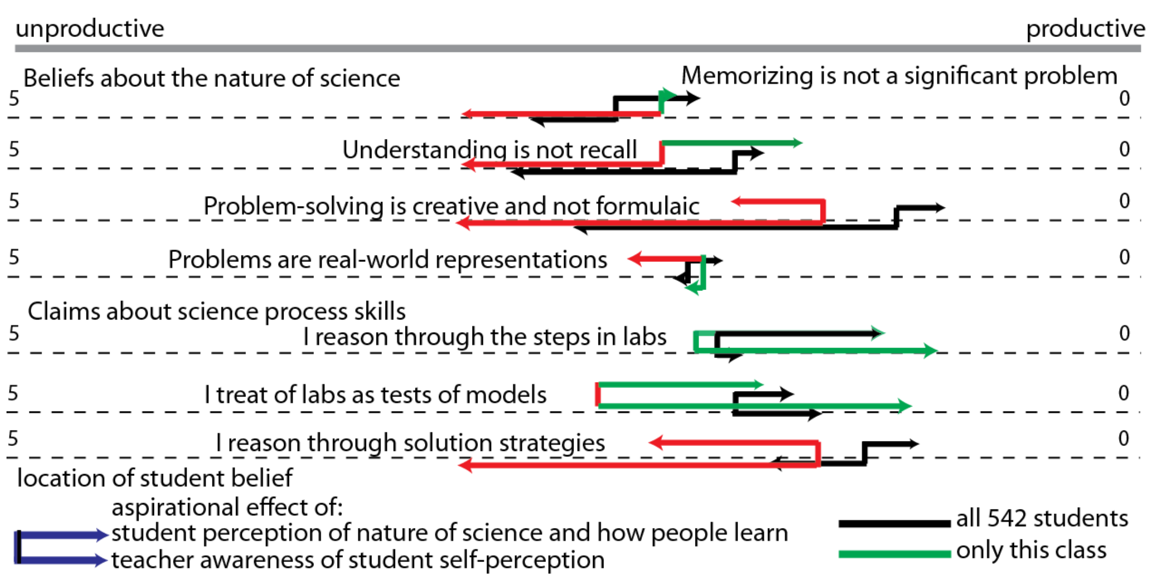


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	9.1%	34.6%	18.2%	22.1%	0.0%	0.1%	18.2%	37.6%	27.3%	0.0%
Q2	45.5%	43.1%	18.2%	38.8%	18.2%	19.8%	36.4%	53.8%	72.7%	15.2%
Q3	27.3%	22.3%	63.6%	35.9%	63.6%	75.5%	45.5%	8.6%	0.0%	69.2%
Q4	18.2%	0.0%	0.0%	3.2%	18.2%	4.6%	0.0%	0.0%	0.0%	15.6%

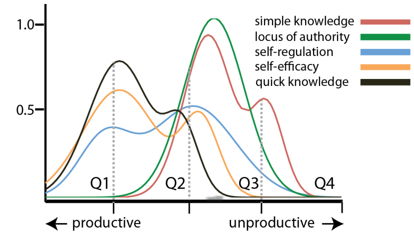
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 2357842 with 24 students reporting 9-9-11 at 9:20

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

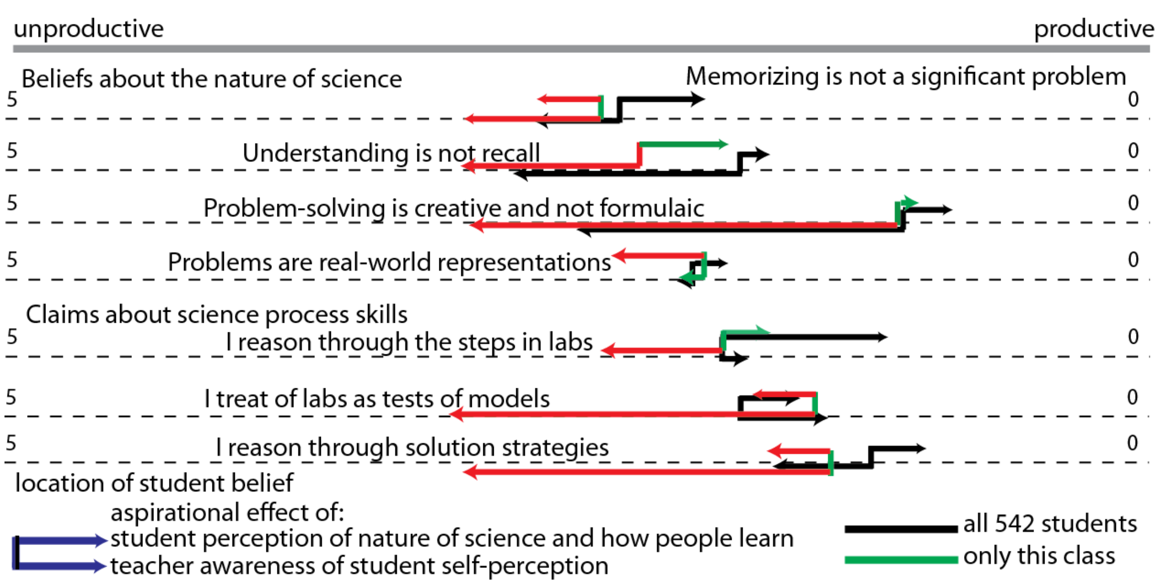


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	4.2%	34.6%	4.2%	22.1%	0.0%	0.1%	0.0%	37.6%	4.2%	0.0%
Q2	41.7%	43.1%	45.8%	38.8%	25.0%	19.8%	37.5%	53.8%	70.8%	15.2%
Q3	41.7%	22.3%	37.5%	35.9%	70.8%	75.5%	50.0%	8.6%	25.0%	69.2%
Q4	12.5%	0.0%	12.5%	3.2%	4.2%	4.6%	12.5%	0.0%	0.0%	15.6%

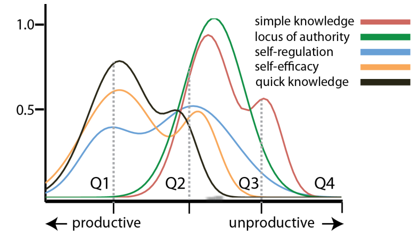
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 2357843 with 18 students reporting 9-9-11 at 10:10

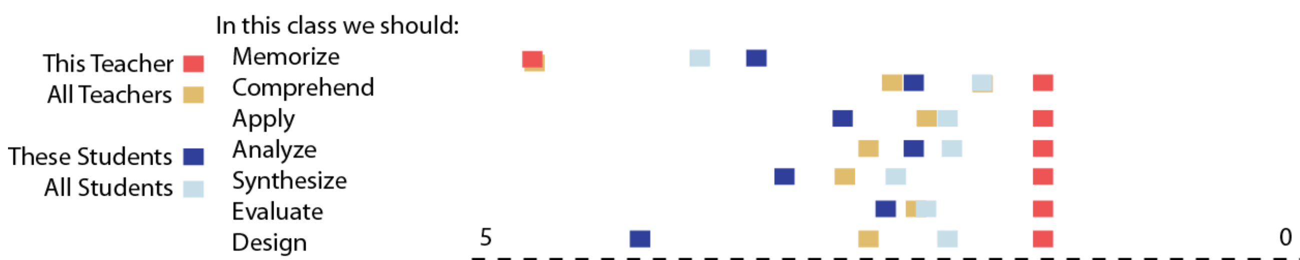
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



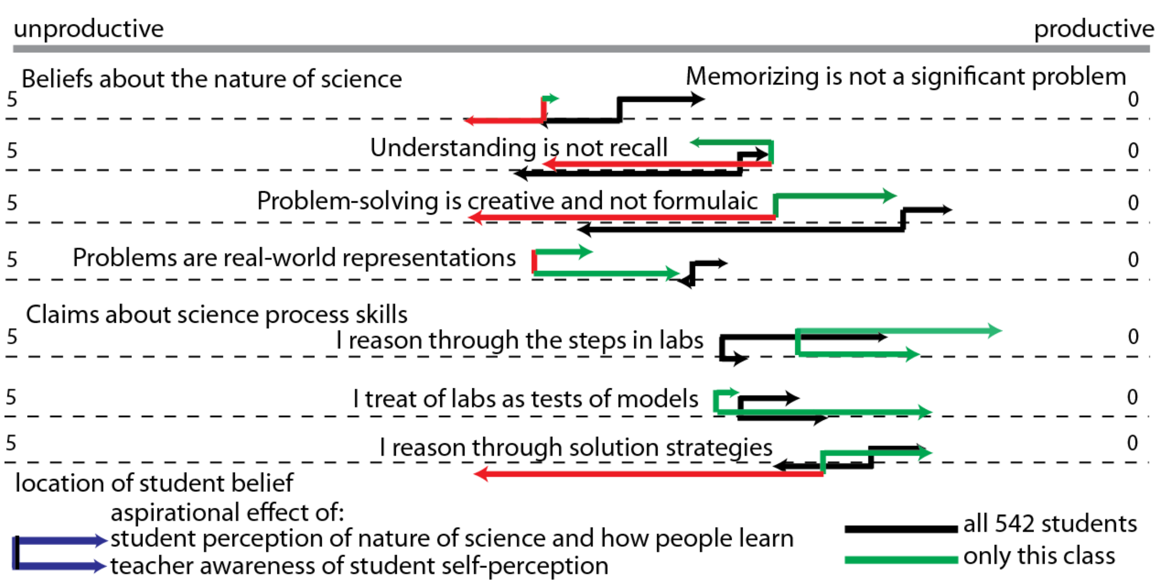
Probability distributions for five learner characteristics

	self-efficacy		self-regulation		locus of authority		quick knowledge		simple knowledge	
quartile	class	CRpop	class	CRpop	class	CRpop	class	CRpop	class	CRpop
Q1	22.2%	34.6%	16.7%	22.1%	0.0%	0.1%	0.0%	37.6%	16.7%	0.0%
Q2	27.8%	43.1%	38.9%	38.8%	22.2%	19.8%	22.2%	53.8%	38.9%	15.2%
Q3	33.3%	22.3%	33.3%	35.9%	61.1%	75.5%	55.6%	8.6%	38.9%	69.2%
Q4	11.1%	0.0%	5.6%	3.2%	11.1%	4.6%	16.7%	0.0%	5.6%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

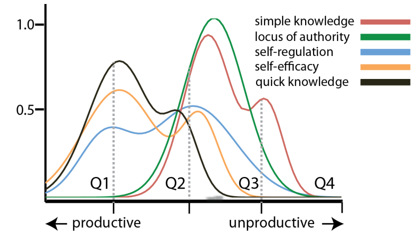


Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 2357844 with 20 students reporting 9-9-11 at 11:00

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

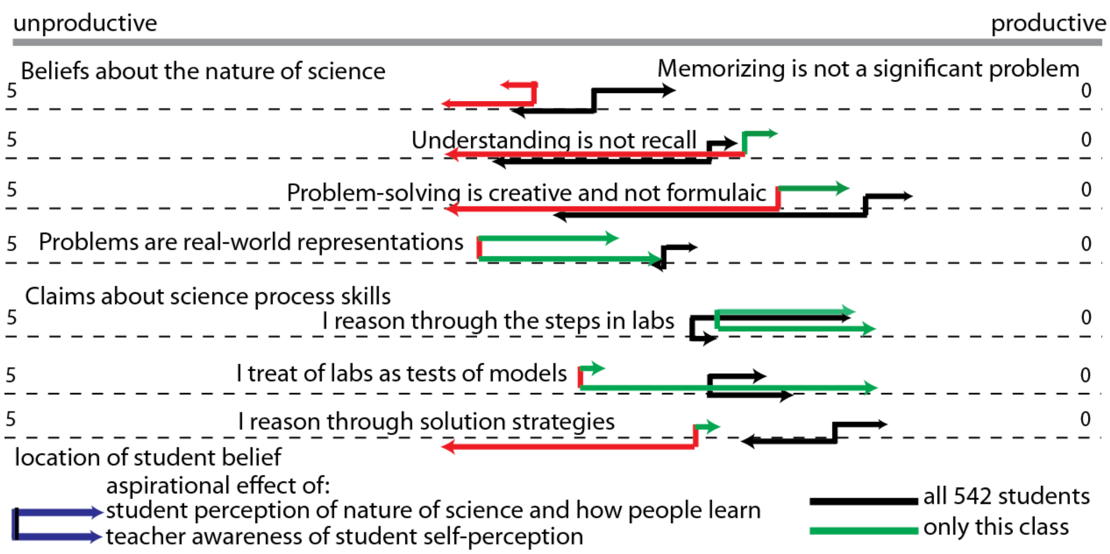


Probability distributions for five learner characteristics

	self-efficacy		self-regulation		locus of authority		quick knowledge		simple knowledge	
quartile	class	CRpop	class	CRpop	class	CRpop	class	CRpop	class	CRpop
Q1	5.0%	34.6%	25.0%	22.1%	0.0%	0.1%	0.0%	37.6%	5.0%	0.0%
Q2	30.0%	43.1%	30.0%	38.8%	20.0%	19.8%	40.0%	53.8%	60.0%	15.2%
Q3	55.0%	22.3%	35.0%	35.9%	80.0%	75.5%	45.0%	8.6%	30.0%	69.2%
Q4	10.0%	0.0%	5.0%	3.2%	0.0%	4.6%	15.0%	0.0%	5.0%	15.6%

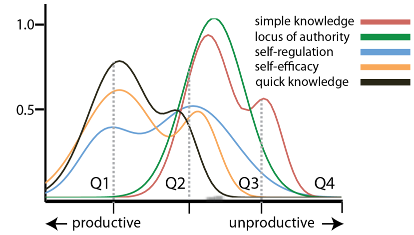
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 2357845 with 17 students reporting 9-9-11 at 13:20

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

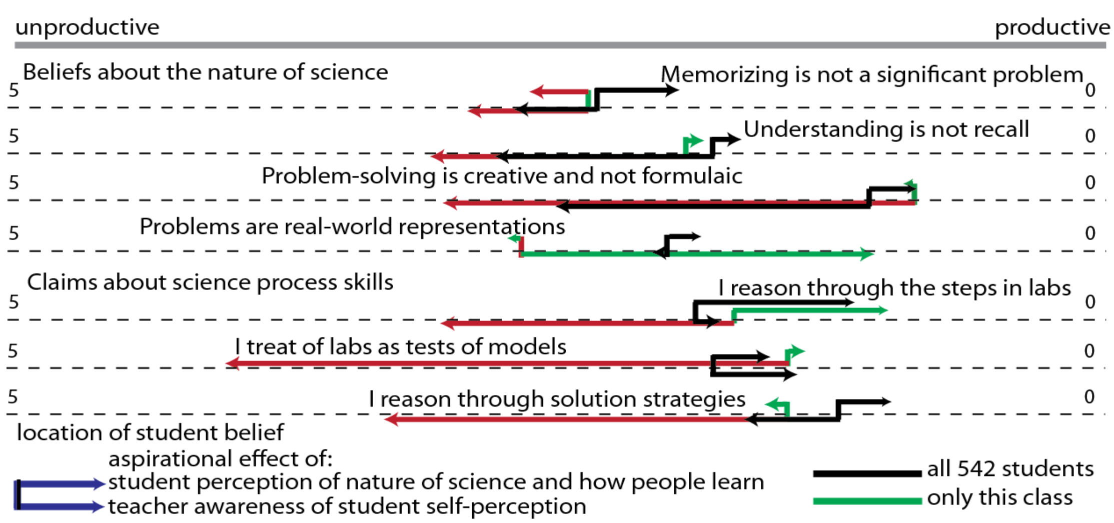


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	11.8%	34.6%	23.5%	22.1%	0.0%	0.1%	5.9%	37.6%	11.8%	0.0%
Q2	35.3%	43.1%	41.2%	38.8%	29.4%	19.8%	35.3%	53.8%	64.7%	15.2%
Q3	47.1%	22.3%	29.4%	35.9%	47.1%	75.5%	52.9%	8.6%	23.5%	69.2%
Q4	5.9%	0.0%	5.9%	3.2%	23.5%	4.6%	5.9%	0.0%	0.0%	15.6%

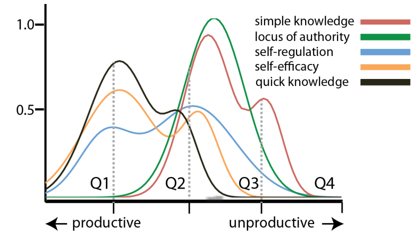
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 2357846 with 15 students reporting 9-9-11 at 14:00

Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.

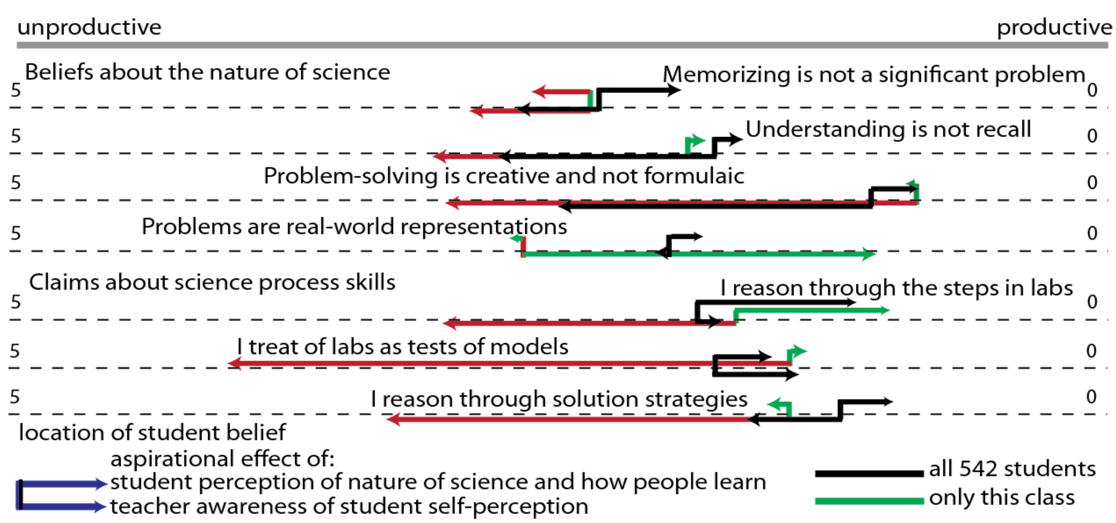


Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	0.0%	34.6%	6.7%	22.1%	0.0%	0.1%	6.7%	37.6%	6.7%	0.0%
Q2	33.3%	43.1%	33.3%	38.8%	40.0%	19.8%	26.7%	53.8%	46.7%	15.2%
Q3	46.7%	22.3%	53.3%	35.9%	60.0%	75.5%	60.0%	8.6%	33.3%	69.2%
Q4	20.0%	0.0%	0.0%	3.2%	0.0%	4.6%	6.7%	0.0%	13.3%	15.6%

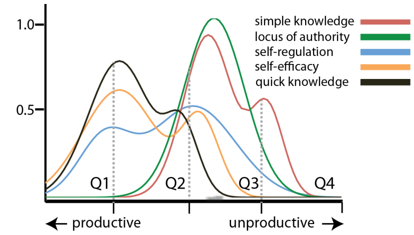
Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.

Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.



Class ID: 2357847 with 26 students reporting 9-9-11 at 14:55

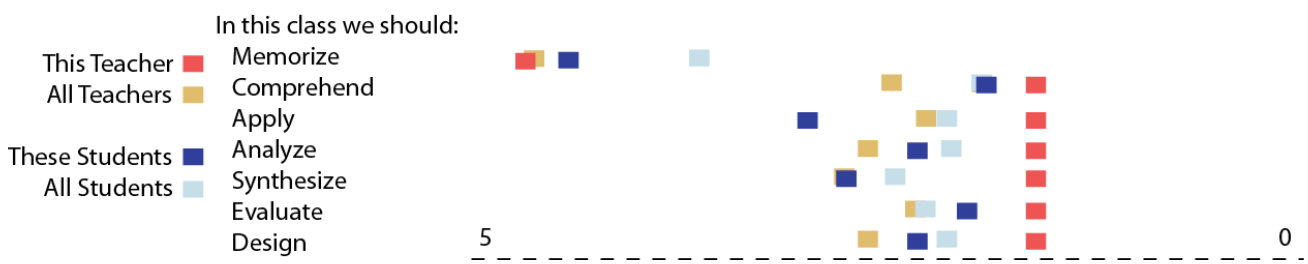
Comparisons of five learning readiness factors show where the class has unusually productive (green) and non-productive (red) characteristics compared to the entire College Ready population shown at the right.
Students who value knowledge that is offered and feel able to acquire it, can direct their own work, accept responsibility for learning, have learned that knowledge often takes time to acquire, and are aware that knowledge can be complex are better able to learn. Instructional strategies can enhance these factors.



Probability distributions for five learner characteristics

quartile	self-efficacy class	self-efficacy CRpop	self-regulation class	self-regulation CRpop	locus of authority class	locus of authority CRpop	quick knowledge class	quick knowledge CRpop	simple knowledge class	simple knowledge CRpop
Q1	15.4%	34.6%	15.4%	22.1%	0.0%	0.1%	0.0%	37.6%	0.0%	0.0%
Q2	34.6%	43.1%	38.5%	38.8%	26.9%	19.8%	26.9%	53.8%	46.2%	15.2%
Q3	26.9%	22.3%	34.6%	35.9%	61.5%	75.5%	57.7%	8.6%	53.8%	69.2%
Q4	23.1%	0.0%	11.5%	3.2%	11.5%	4.6%	15.4%	0.0%	0.0%	15.6%

Comparison of student and teacher identification of reasoning and process skills from Bloom's taxonomy that should (0) and should not (5) be part of the course describes the intended curriculum from each perspective.



Student beliefs about the nature of science and claims of process skills can support learning with productive models. Teacher predictions of student perspectives and student predictions of expert perspectives might be aspirational and provide instructional goals. These predictions might indicate teacher or student misconceptions. In class assessment can discriminate among these possible interpretations and inform instruction.