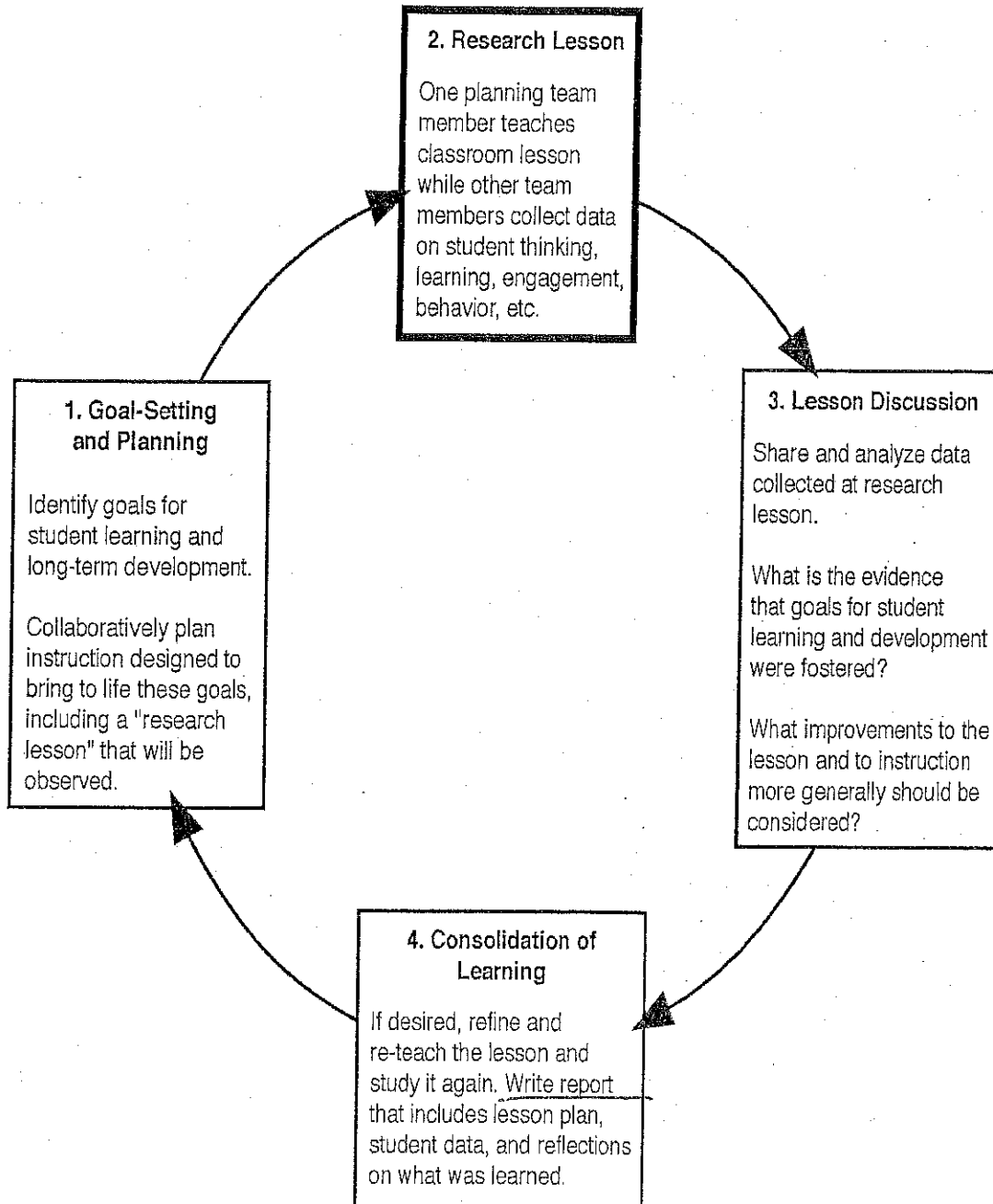


Figure 1
Japanese Lesson Study Cycle



Academic Silo

Career Tech 2110

- * Integrate CTE & academics in CTE currc.
- * PD

Japanese Lesson Study (Chokshi)
Math PD model - used for elem in Japan

Math-in-CTE (Stone)
Secondary

math teachers
collaborate on
planning "research lesson"
to meet ed goal,
observe lesson in
action, reflecte
refine,
write report
to share

See Math-CTE teachers
 team teach the math,
 map the math,
 create - teach lesson

The “Seven Elements” of a Math-Enhanced CTE Lesson

1. Introduce the CTE lesson.

- Explain the CTE lesson.
- Identify, discuss, point out, or pull out the math embedded in the CTE lesson.

2. Assess students’ math awareness as it relates to the CTE lesson.

- As you assess, introduce math vocabulary through the math example embedded in the CTE.
- Employ a variety of methods and techniques for assessing awareness of all students, e.g., questioning, worksheets, group learning activities, etc.

3. Work through the math example embedded in the CTE lesson.

- Work through the steps/processes of the embedded math example.
- Bridge the CTE and math language. The transition from CTE to math vocabulary should be gradual throughout the lesson, being sure never to abandon completely either set of vocabulary once it is introduced.

4. Work through *related, contextual math-in-CTE examples*. Using the same math concept *embedded* in the CTE lesson:

- Work through similar problems/examples in the same occupational context.
- Use examples with varying levels of difficulty; order examples from basic to advanced.
- Continue to bridge CTE and math vocabulary.
- Check for understanding.

5. Work through *traditional math examples*.

Using the same math concept as in the *embedded and related, contextual examples*:

- Work through traditional math examples as they may appear on tests.
- Move from basic to advanced examples.
- Continue to bridge CTE and math vocabulary.
- Check for understanding.

6. Students demonstrate their understanding.

- Provide students opportunities for demonstrating their understanding of the math concepts embedded in the CTE lesson.
- Conclude the math examples back to the CTE content; conclude the lesson on the topic of CTE.

7. Formal assessment.

- Incorporate math questions into formal assessments at the end of the CTE unit/course.

CTE Problem | CTE Unit | CTE Concepts | ^{Prerequisite} Math Concepts

Core Principles of the NRCCTE Model for Enhancing Math-in-CTE

(Process)(Pedagogy) = Math Achievement	
Principle	Processes
<p>A. Develop and sustain a community of practice.</p>	<p>Cohorts of CTE-math teacher teams are formed around specific occupational foci or CTE content (e.g. business, auto technology, health).</p> <p>Administrators/school districts/professional organizations provide structure and support to build and sustain communities of practice including:</p> <ul style="list-style-type: none"> • Regular professional development that brings the communities of practice together several times during the academic year. • External “stimuli” to keep teachers focused on the math interventions. • On-going support for CTE teachers for development and implementation of math-enhanced lessons.
<p>B. Begin with the CTE curriculum, not with the math curriculum.</p>	<p>CTE-math teacher teams <i>interrogate the curriculum</i> to identify the math embedded in the CTE curriculum</p> <p>CTE-math teacher teams create curriculum maps that identify the intersection of occupational content and math constructs/concepts.</p> <p>CTE teachers use a scope and sequence to guide implementation of math-enhanced CTE lessons.</p>
<p>C. Address the math in CTE as an essential workplace skill.</p>	<p>CTE-math teams generate math examples in which students solve authentic workplace problems.</p> <p>CTE teachers introduce and reinforce math as a “tool” to use in the workplace.</p> <p>CTE teachers bridge CTE and math vocabulary as they develop and teach the lessons.</p>
<p>D. Maximize the math in CTE curricula.</p>	<p>CTE-math teacher teams continue to locate as much math as possible in the CTE curricula throughout the year.</p> <p>CTE teachers build on students’ prior math knowledge and skills.</p> <p>CTE teachers capitalize on teachable moments that follow the math enhanced lessons.</p>
<p>E. Support CTE teachers as “teachers of math-in-CTE,” not as math teachers.</p>	<p>CTE teachers participate in professional development activities that enable them to teach the math as it occurs in their CTE content, a process that involves:</p> <ul style="list-style-type: none"> • helping CTE teachers learn more about the math concepts in their CTE curricula. • helping CTE teachers learn math formulas and vocabulary. • providing opportunities for CTE teachers to practice teaching the math in their curricula.

Lesson Title: How Much Fertilizer to Apply
Occupational area: Horticulture
CTE concepts:
Math concepts:

Lesson xxxxxxxxxxxxxxxxxxxxxxxxxxxx Objective:	Students will demonstrate a working knowledge of calculating the amount of fertilizer need to apply to an area to deliver the required amount of fertilizer elements.
Supplies Needed:	Christians, N. & Agnew, M. (2000) The mathematics of turfgrass maintenance 3 rd Edition. Mathematics Lesson Handout
The "7" Elements	Teacher Notes
1. Introduce the CTE lesson	This lesson will follow the lesson on The problems introduced will use the procedures used in the previous lesson. How much 20-5-15 fertilizer would have to be purchased to apply .75 lb Nitrogen/1,000ft ² to 55,000 ft ² of golf course greens? *
2. Assess students' math awareness as it relates to the CTE lesson.	1. How many pounds of fertilizer will provide .75 lbs of N ? 2. How much fertilizer will be needed to treat 55,000 ft ² ?
3. Work through the math example embedded in the CTE lesson.	1. 20% of what amount = .75 lb N? .20 x = .75 X = 3.75 lb of fertilizer / 1000 ft ² 2. If 3.75 lb for each 1,000 ft ² X lb for each 55,000 ft ² $\frac{\text{Lb}}{\text{ft}^2} \quad \frac{3.75}{1000} = \frac{X}{55000}$ $(3.75) (55000) = 1000 X$ $\frac{206,250}{1000} = X$ $206.25 \text{ lb} = X$

<p>4. Work through <i>related, contextual math-in-CTE</i> examples.</p>	<p>1. How much fertilizer will be needed to treat 100,000 ft² 2. How many pounds of 18-5-9 fertilizer would need to be purchased to apply .75 lb N / 1000 ft²?</p>
<p>5. Work through <i>traditional mathematics</i> examples. How much phosphorus (P) and potassium (K) are in a 50 lb bag of 18-5-9 fertilizer?</p>	<p>Need to know percentage of phosphorus in phosphoric acid and potassium in potash Need to know: P₂O₅ is 44% P K₂O is 83% K Amount of phosphoric acid in bag (.05) (50) = 2.5 lbs P₂O₅ Amount of potash in bag (.09) (50) = 4.5 lbs K₂O Amount of Phosphorus in bag (.44) (2.5) = 1.1 lbs P Amount of Potassium in bag (.83) (4.5) = 3.735 lbs K</p>
<p>6. Students demonstrate their understanding (worksheets)</p>	
<p>7. Formal Assessment Including 1 procedural and 1 application from <i>traditional mathematics</i>.</p>	

Pilot Methodology

- Participants
- 5 math fac
 - 5 CTE fac
 - 1 research coord.
 - 1 univ math ed prof

Setting
- Public comm college in Midwest

Funding Delin Comm Coll Bd,
State Bd of Ed, Perkins IV Grant

Activities

- Intro, ice break
- CTE faculty demo contextual CTE math
- Math instr develop research lesson
- CTE inst & Math inst enact research lesson together
- all meet to reflect & develop process
- math lesson is refined & reteaching will occur.

Findings

- Math teachers became aware of CTE math
- CTE teachers acquired math ed pedagogy
- Faculty collaboration

Next Steps

- analyze data from surveys
- conceptualize framework
- Mentor new participants

9. Right now a priority for me is finding out what integrated instruction involves.

1 2 3 4 5

10. Right now a priority for me is finding out what lesson study involves.

1 2 3 4 5

11. Right now a priority for me is figuring out how to teach proportional reasoning in my class.

1 2 3 4 5

12. Right now a priority for me is figuring out how to do integrated instruction in my own classroom.

1 2 3 4 5

13. Right now a priority for me is figuring out how to do lesson study in my own classroom.

1 2 3 4 5

14. Students' understanding of proportional reasoning is enhanced by integration of math and CTE instruction.

1 2 3 4 5

15. Lesson study is an effective way to integrate instruction in proportional reasoning and CTE and to observe how and what students are learning.

1 2 3 4 5

16. It would be difficult for me to tell an instructional peer that he (she) needs to change something about his/her lessons.

1 2 3 4 5

17. It would be difficult for me to accept suggestions from an instructional peer about improving my lessons.

1 2 3 4 5

18. Integrated instruction would be effective in other contexts to improve learning.

1 2 3 4 5

19. Lesson study would be effective in other contexts to improve instruction.

1 2 3 4 5