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Helping Students Learn Problem Solving – Forming An Initial Model of Instructors' Beliefs*

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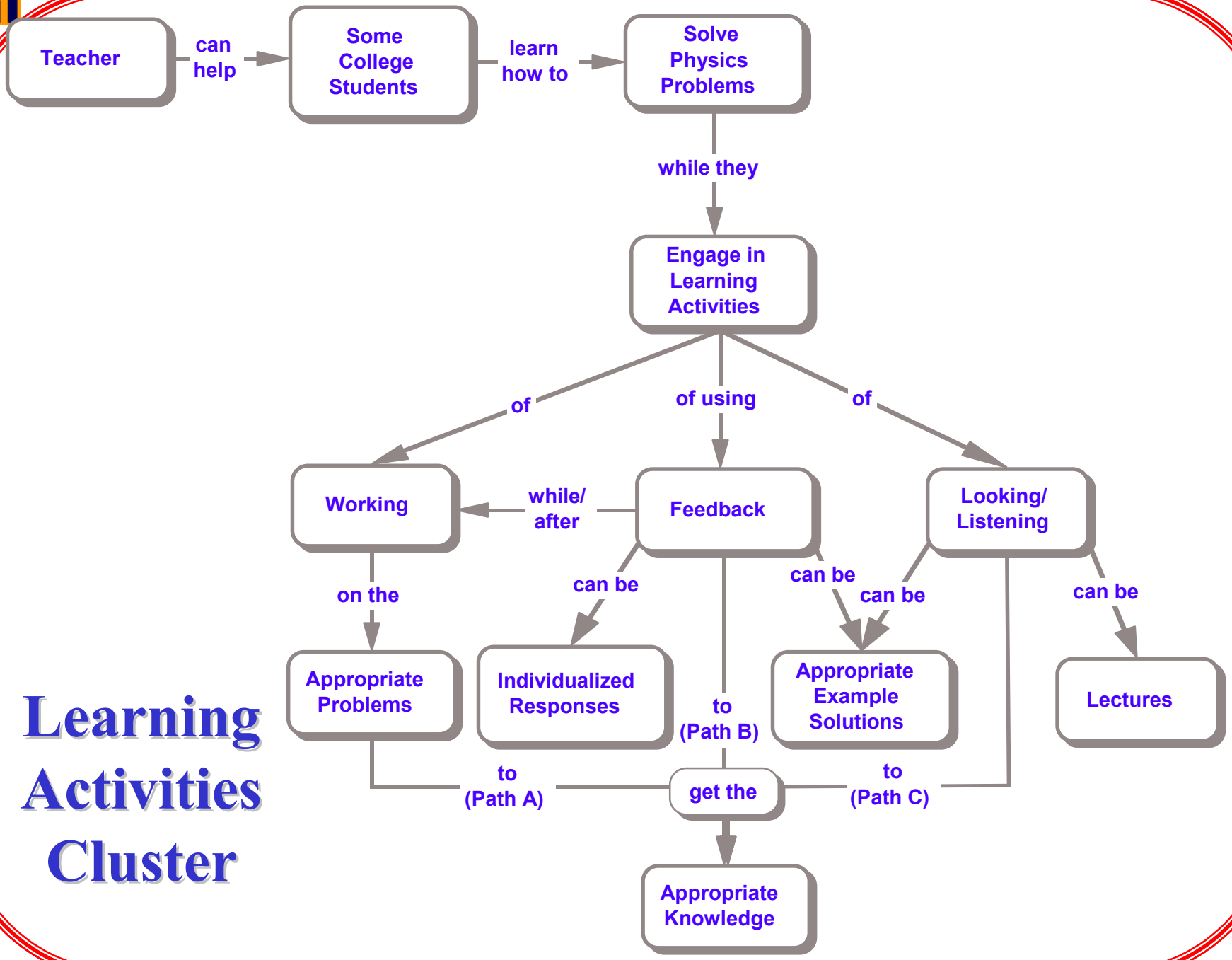
Motivation

Instructors' beliefs about teaching influence their use (or non-use) of curricular materials

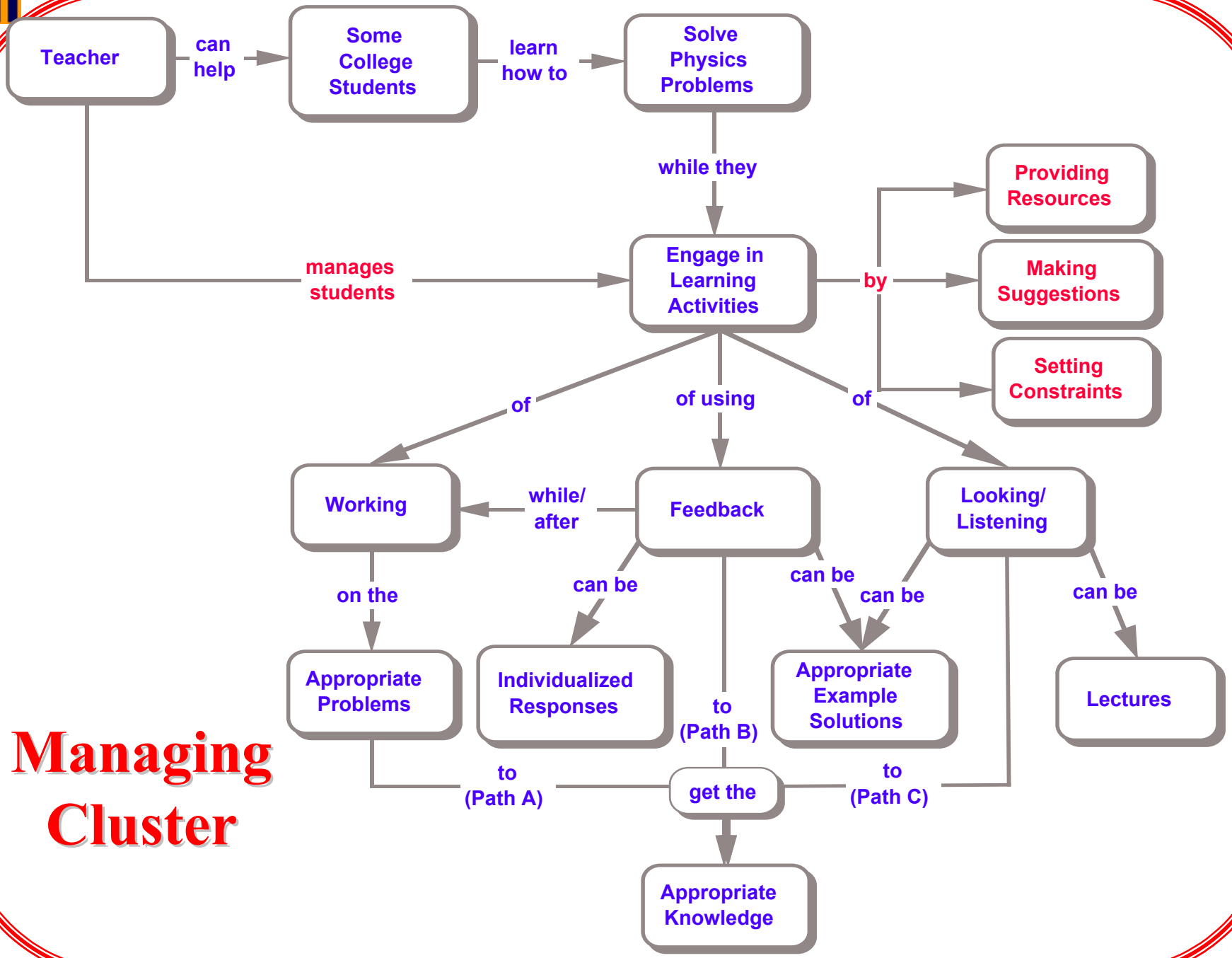
Knowing these beliefs could help curriculum developers make these materials more acceptable

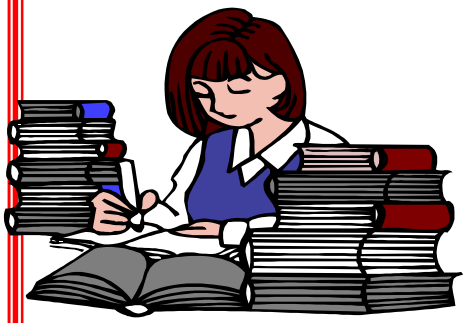
Everything in this talk is about the instructors' beliefs about their own teaching, not about what they actually do!

Learning Activities Cluster



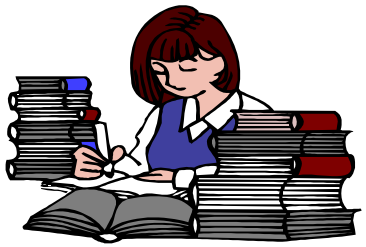
Managing Cluster





Managing students working on problems

Working



A. Providing Resources

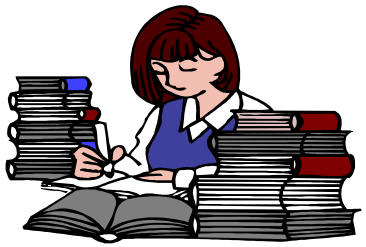
- **Choose appropriate problems**

  i. **Requires consideration of physics principles behind the problem**

  ii. **Conveys the message that physics is related to reality by posing problems in realistic or semi-realistic context**

  iii. **Is based on the current state of the students' knowledge**

Working

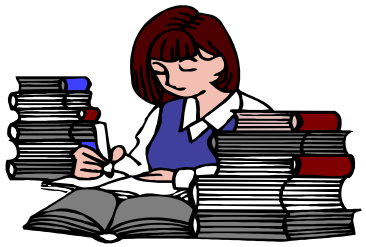


B. Making Suggestions

- **Practice working on a lot of appropriate problems**
- **Particular techniques to enhance student learning**
  - **e.g. students should first guess at the answer, and after having worked through the problem, compare their guess to the calculated answer**

There was no justification on why they believe these suggestions enhance student learning

Working



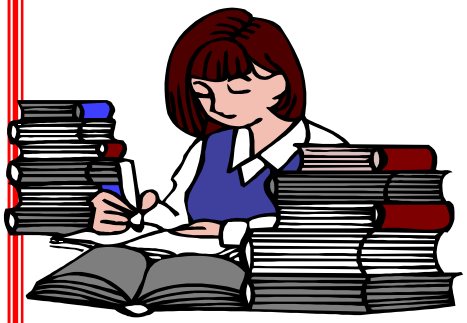
C. Setting Constraints

- **Collecting homework**
- **Giving tests**

  only situation where students work seriously on a problem without prematurely looking for help

Most instructors do not view the act of taking tests to be beneficial to learning

They believe that students can learn from the feedback after taking the test



Managing students working on problems

Managing students using feedback

Teacher
can help
Some College Students
learn how to
Solve Physics Problems
while they
manages students
Engage in Learning Activities
by
Providing Resources
Making Suggestions
Setting Constraints
of
of using
of
Working
while/ after
Feedback
Looking/ Listening
on the
can be
can be
can be
can be
Appropriate Problems
Individualized Responses
Appropriate Example Solutions
Lectures
to (Path A)
to (Path B)
to (Path C)
get the
Appropriate Knowledge

Using Feedback

- **There are 2 opportunities to provide useful feedback**

1. ***While** student is solving a problem*
   - ***i.e. Coaching***
2. ***After** student has solved a problem*
   - ***e.g. Providing example problem solutions or Grading***

Instructors believe both are equally effective

Using Feedback

A. Providing Resources (time)

i. **Written example problem solutions**

ii. **Personal Coaching (feedback while students work)**

- **Peer Coaching**
- **Instructor Coaching**

Advantage of Peer Coaching: requires considerably less instructor time (almost as helpful as Instructor Coaching)

iii. **Grading on tests**

Unfortunately, instructors' grading often countered the values that they wish to communicate (Kuo, et. al., PERC Proceedings, Rochester, NY, 2001)

Using Feedback

B. Making Suggestions

- **Students should first work on problems, and then come to office hours when having difficulties**

  Even though they believe that very few students do this

- **Instructors placed a high value on their coaching**

  Student surveys rated instructor office hours as one of the least valuable resources

Using Feedback

C. Setting Constraints

- **Instructors did not express the belief that they should set constraints to influence feedback usage**

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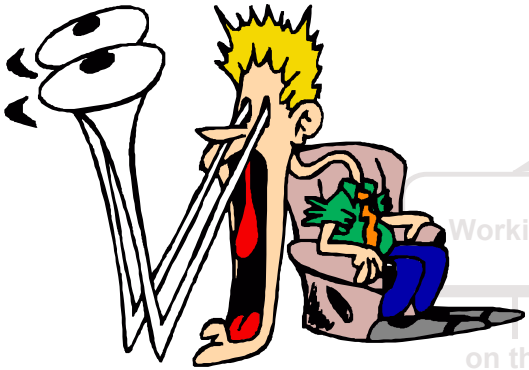
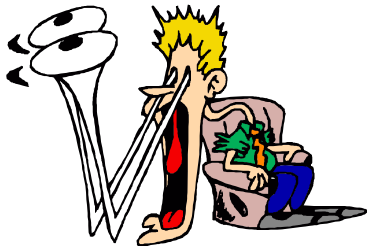


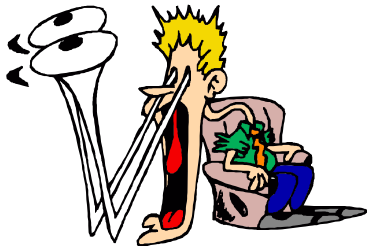
Managing students looking / listening



Looking/Listening

- **Instructors manage only by providing resources**

Instructors did not express the belief that they should either make suggestions on how students should use this information or influence students to use the information by setting constraints



Looking/Listening

A. Providing Resources

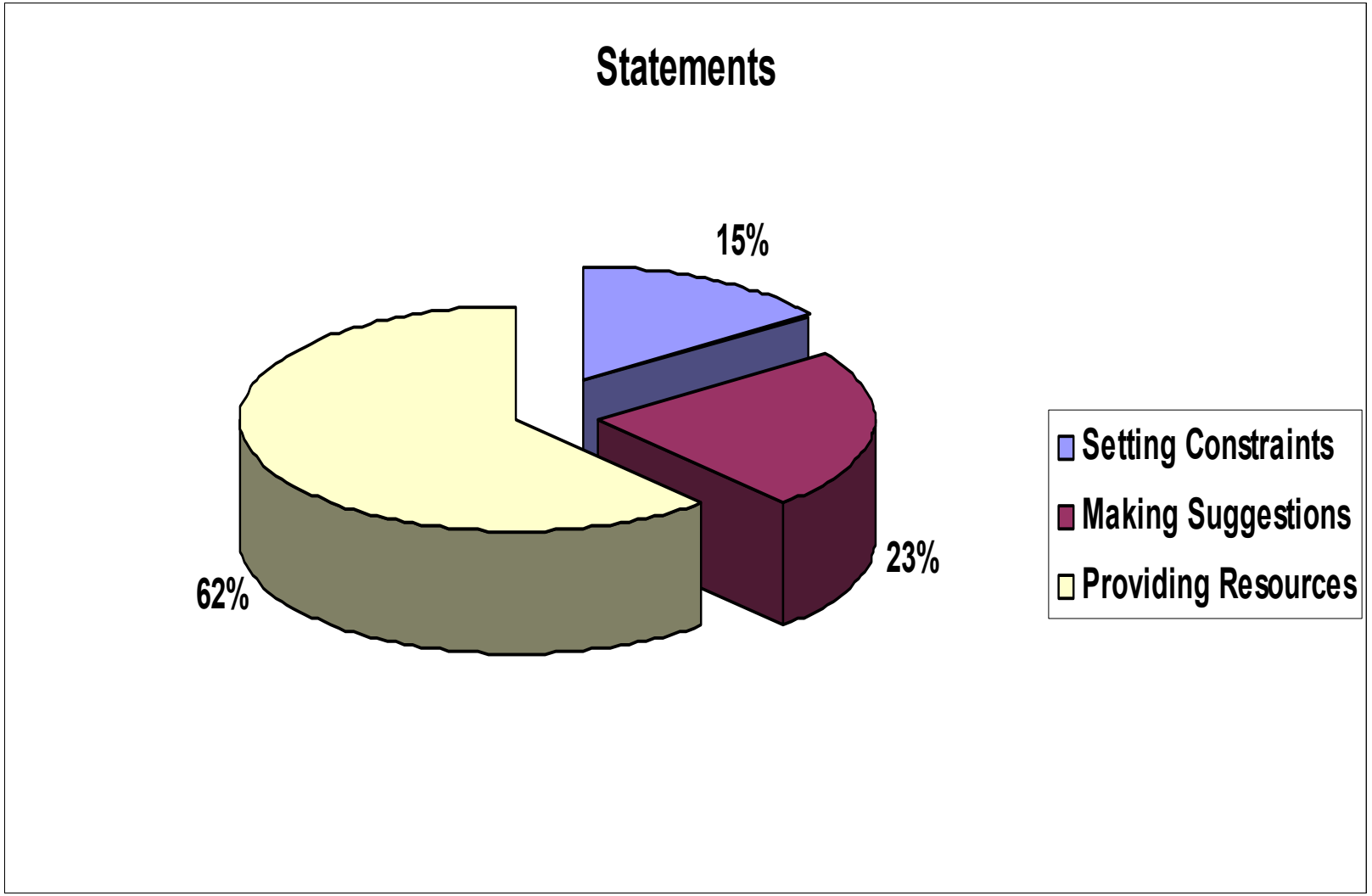
i. **Posting example problem solutions**

ii. **Solving problems during lecture**

iii. **Lecturing about specific problem-solving techniques**

iv. **Presenting interesting example problems**

Summary of Management



Caution!

Hypothesis was developed with a sample of 6 research university faculty

Will be tested using a broader sample

Implications

Instructors spent the most time discussing management of feedback

They do not spend significantly more time preparing feedback than on other teaching activities

- ✓ ***Curriculum developers could promote alternative instructional approaches by highlighting this conflict***
- ✓ ***e.g. more advanced class response systems that allow instructors to provide immediate feedback for problem solving during lecture***

Implications

Instructors did not frequently considered constraining students

It is important to know how instructors perceive constraints

- **Many curricular material are designed to promote problem solving by constraining students to use a problem-solving framework (e.g. Van Heuvelen, 1991; Heller, Keith, & Anderson, 1992; Heller & Hollabaugh, 1992; Leonard, Dufresne, & Mestre, 1996; Reif & Scott, 1999)**

Implications

- ***If instructors***
  - ***in principle, oppose constraining students***
    - **Students should take responsibility for their own learning**

      ✓ ***Curricula need to be revised to soften the importance of the constraints***

  - ***lack specific knowledge to appreciate the value of constraints***

    ✓ ***Appropriate professional development could be designed to make this type of material more acceptable***

In Conclusion

1. Instructors believe their teaching consists of managing 3 distinct ways by which students learn to solve physics problems!

2. Knowledge about these beliefs could help guide curriculum developers!

To be continued …

Thank you!

For more information, please visit our website at:

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