Using Action Research in My Classroom to Increase Expertise in Teaching Physics

Alliance for Physics Excellence (APEX)
Physics Teaching Research Program (PTR)

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APEX PTI Cohort 2 Summer Program, June 15-26, 2015

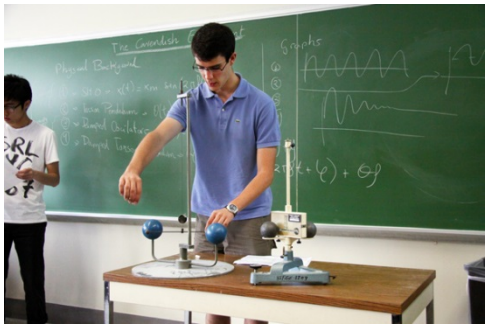
Alliance for Physics Excellence

The goal of the *Alliance for Physics Excellence* (APEX) program is to integrate research-based teaching practices into Alabama physics classrooms via in-service teacher education, and evaluate the impact on physics teachers and their students in the state's school systems.

Teacher Action Research

Action Research is the only strategy for extending APEX professional development and facilitating and sustaining change this year and in the future.

There are several forms, we all use one.



Action Research Facilitates Change in Beliefs

- Over the last two years we said……
  - ***All teachers have beliefs which guide their teaching.***
  - ***Beliefs are constructions of reality.***
  - ***Can you determine which of your beliefs are "truthful" or "misconceptions"?***
  - ***The process of changing is the process of changing beliefs.***
  - ***<u>How do you change beliefs?</u>***
  - ***How can you change your beliefs about physics teaching?***

Professional Development through Teacher Action Research

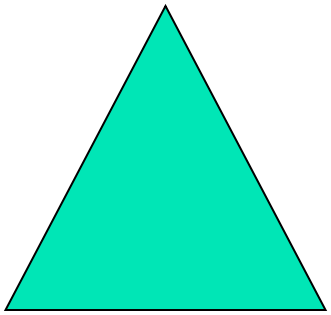
What data driven evaluation process will you use to monitor your progress in using the APEX PTI information and understandings?

- **How can a classroom action research study add to your understanding of teaching and learning?**
- **What different kinds of evidence are you using to answer your action research question?**

Three sources are needed to give you confidence and understand the result.

Different Kinds of Evidence Used?

1.



2.

3.

How can these three sources work together to answer your question?

- FCI or other comparison tests based on student prior knowledge conceptions
- Progress on Diagnoser questions
- Student individual or small group interviews
- Students' portfolio of work on Diagnoser lessons
- Results on standard physics tests
- Suggest others

APEX Cohort 1: PTI Action Research Results

You know the results from your individual action research studies you completed with the Force and Motion Units taught in 2014-15.

The results from all Cohorts 1 and 2 unit studies completed are also useful in planning your future changes.

Student Results from Pre and Post FCI Tests with Force and Motion Unit

Cohorts 1 (6 classes) **and 2** (14 classes)

Number of students = 511

Maximum rating possible = 15 or 100%

Pre test cumulative score = 22.2

Range = 14.3 - 67.4

Post test cumulative score = 41.7

Range = 17.0 – 84.1

Sig. Diff between pre and post test scores

Significance = 0.000

Effect size = 0.447

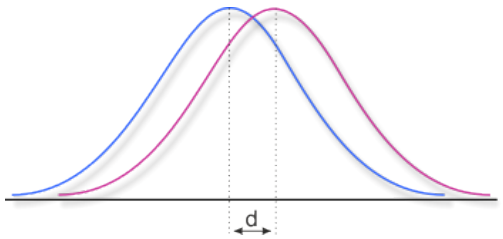
Percentile gain = 17%

0.10 = Small Effect size

0.30 = Med Effect size

0.50 = Large Effect size

Jacob Cohen, 1988, Hedges & Olkin, 1985



Student Results from Pre and Post FCI Tests with Force and Motion Unit

Cohort 1 (6 classes)
Number of students = 179

Maximum rating possible = 15 or 100%

Pre test cumulative score = 20.4

Range = 14.3 - 67.4

Post test cumulative score = 35.2

Range = 17.0 – 84.1

Sig. Diff between pre and post test scores

Significance = 0.000

Effect size = 0.358

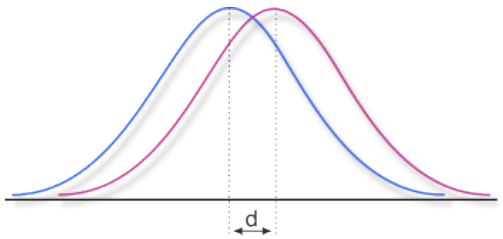
Percentile gain = 14%

0.10 = Small Effect size

0.30 = Med Effect size

0.50 = Large Effect size

Jacob Cohen, 1988, Hedges & Olkin, 1985



Student Results from Pre and Post FCI Tests with Force and Motion Unit

Cohort 2 (14 classes)
Number of students = 332

Maximum rating possible = 15 or 100%

Pre test cumulative score = 24.0

Range = 17.1 – 31.0

Post test cumulative score = 48.3

Range = 23.3 – 92.7

Sig. Diff between pre and post test scores

Significance = 0.000

Effect size = 0.520

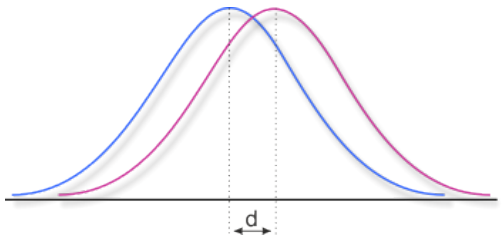
Percentile gain = 20%

0.10 = Small Effect size

0.30 = Med Effect size

0.50 = Large Effect size

Jacob Cohen, 1988, Hedges & Olkin, 1985



Student Results from Pre and Post FCI Tests with Force and Motion Unit

Cohort 1 (6 classes) **and** No. of students = 179

Pre test cumulative score = 22.2

Range = 14.3 - 67.4

Post test cumulative score = 41.7

Range = 17.0 - 68.7

No Sig. Diff between Pre test Cohorts F(1,510)= 0.011, Alpha= .918

Cohort 2 (14 classes)

No. of students = 332

Pre test cumulative score = 24.0

Range = 17.1 – 31.0

Post test cumulative score = 48.3

Range = 23.3 – 92.7

Sig. Diff between Post tests of Cohorts F(1,498) =35.69, Alpha= .000

Student Results from Pre and Post FCI Tests

- **What do the action research results mean to you as a member of a collaborative group of physics teachers?**
- **What limitations are there for this data?**
- **How does this affect the predictions we can make?**

Making the Student Results Meaningful – Survey 1

1. Identify the dates and changes you made to your physics units last year.

- **Force and Motion Unit:**
- Dates taught in 2014-15 were –
- Changes from teaching in 2013 were –

2. Percent of the lesson activities/teaching methods/ that were changed in the unit from your baseline units taught in 2012 or earlier?

Circle one 0% 5% 15% 25% 35% 45% 55% 65% 75% 85% 95% 100%

3. Percent of the lesson activities/teaching methods/ that were changed in the unit from your baseline units taught in 2012 or earlier?

Circle one 0% 5% 15% 25% 35% 45% 55% 65% 75% 85% 95% 100%

Making the Student Results Meaningful – Survey 1

- **How did your action research study add to your understanding of effective physics teaching?**
- **What will you do the next time you teach the unit, based on what you found?**
- **What changes are you interested in introducing next year?**

APEX Cohort 1: PTI Action Research Reflection Activity

Physics Units taught in Fall/Spring 2014-15

Based on your reflections on teaching physics, as a result of APEX workshops during 2014-15, describe your understanding (beliefs) of effective teaching physics next year?

Reflections on Teaching Physics Next Year

1. Describe how you will change the Force and Motion unit you will teach during fall 2015.

2. What will be different?

3. What kinds of results/products will these changes produce?

Reflections on Teaching Physics Next Year

4. What will be different from what you did previously that did not work well?

What evidence can you provide for this?

Reflections on Teaching Physics Next Year

5. What do you want to try that you did not do yet?

Reflections on Teaching Physics at Next Year

- **1. Describe how you will change the Force and Motion unit you will teach during fall 2015.**
- **2. What will be different?**
- **3. What kinds of results/products will these changes produce?**
- **4. What will be different from what you did previously that did not work well? What evidence can you provide for this?**
- **5. What do you want to try that you did not do yet?**

Making Your Practice More Expert - Survey 2

- **Describe the Action Research process that will help you monitor your progress using the APEX PTI information and understandings from this summer in the next academic year, 2015-16.**
- **Complete Survey 2**

Reflections on Teaching Physics at This Time

6. How can share and disseminate what you have done in your classroom as innovative teaching?

Places to Share: Discuss at your table & complete Survey 3

- **Alabama Science Teachers Association (ASTA)**
- **February 16-17**
- Proposal date ?
- 2016 ASTA Conference
- Birmingham, Alabama

- **American Association of Physics Teachers (AAPT)**
- Proposal date?
- Meeting Date in 2016

Your Local School Region

- With one or two teachers

APEX Cohort 1: Action Research Activity with Two Units during the Fall 2015 to Spring 2016 Academic Year

- **Description of context** of the units 1) Force and Motion unit and 2) Electricity unit. The units can be reduced in content covered.
- **Lesson plans** or lesson outline of unit
- **Daily diary of events** that occurred
- Administer students' **pre and post revised FCI, EMCI and, if possible Diagnoser tests**
- **Interview** your students
- Narrative reflective **summary** of the action research activity- **What did you learn? What was the evidence?**
- **Present**, **compare, and reflect** on your results during the APEX weekend workshops of the 2015-16 school year

Sustaining APEX Changes

The overall goal of the APEX VPLC is building capacity and sustainability during and after APEX.

- This can be measured by
  - APEX teachers' sustained participation in the VPLC
  - Changes in APEX teachers' "professional vision" while using the VPLC
  - APEX teachers willingness and ability to become leaders in Alabama in physics education.

Sherin & van Es, 2009

APEX Website

- The URL for the APEX website is:
  - **apex.ua.edu**
  - APEX Cohort 1 is a page specifically for information for Cohort 1, 2, & 3 participants.
  - Blog – is a blog site for questions and comments about physics, physics lessons, and the APEX workshops that are to be shared with other cohort 1 members and the University of Alabama content area specialist.
  - Sites are password protected. Name is: **your email address** & the password is: **make your own up**

Inquiry Teacher's Actions and Students' Responses

Essential Features of Classroom Inquiry and Their Variations

Essential Features of Inquiry	1 Full Inquiry Teaching (Can Use Learning Cycle)	2 Coupled Inquiry (Can Use Learning Cycle)	3 Guided Inquiry	4 Directed Inquiry	5 Verification	6 Expository

More <_____ Amount of Learner Self-Direction _____ Less

Less <_____Amount of Direction from Teacher or Material _____More

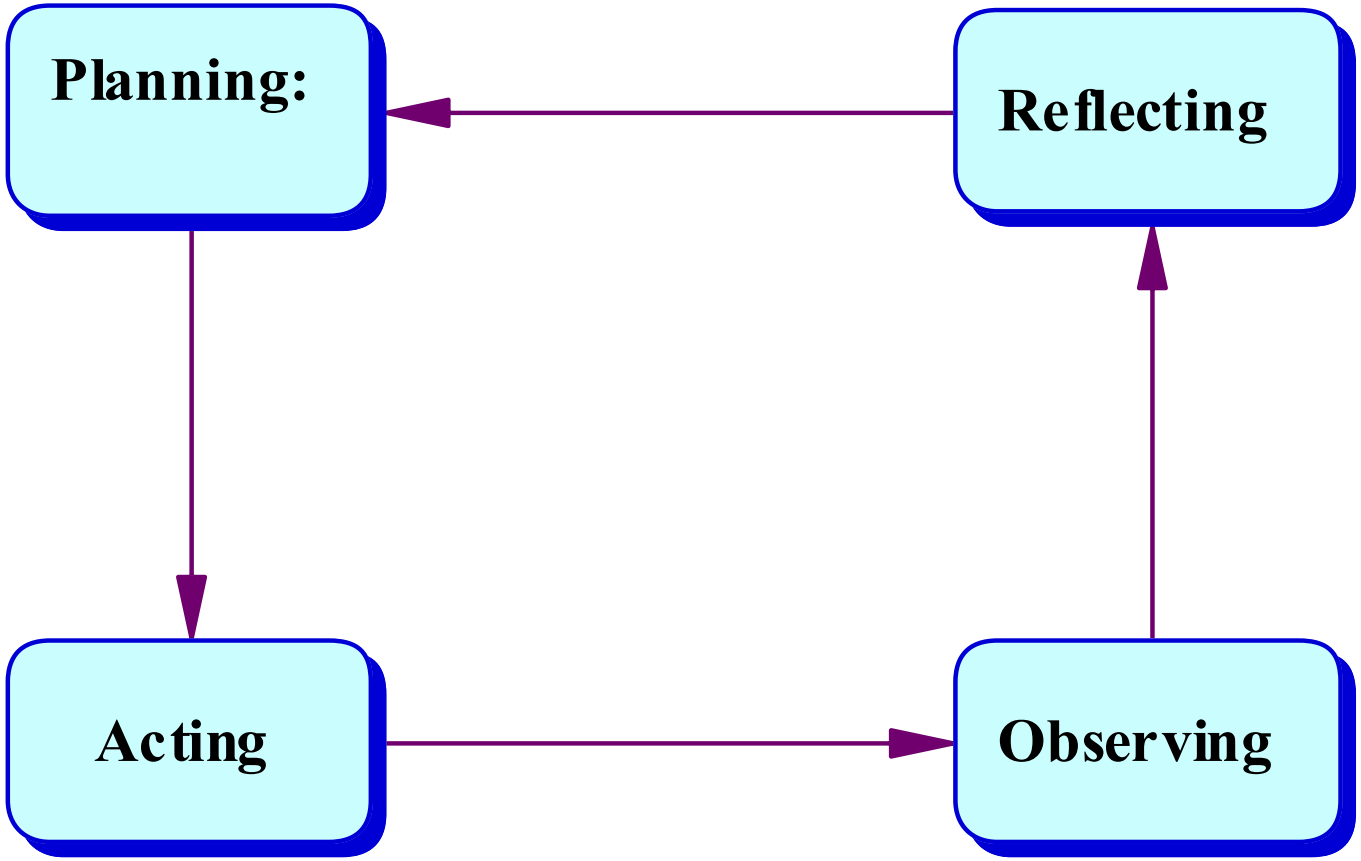
Essential Features of Inquiry	1 Full Inquiry Teaching (Can Use Learning Cycle)	2 Coupled Inquiry (Can Use Learning Cycle)	3 Guided Inquiry	4 Directed Inquiry	5 Verification	6 Expository
1. Learner engages in scientifically oriented questions	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials, or other source	Learner engages in question provided by teacher, materials, or other source	Learner engages in question that replicates one provided by teacher, materials, or other source	Learner engages in no question to investigate
2. Learner gives priority to evidence in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze	Learner given data and told how to analyze that replicates one provided	Learner given no data just conclusions
3. Learner formulates explanations from evidence	Learner formulates explanation after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence	Learner provided with evidence that replicates conclusions already given	Learner provided with no evidence, only conclusions
4. Learner connects explanations to scientific knowledge	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	Learner provided with connections	Learner provided with connections that replicates one provided	Teacher reports connections
5. Learner communicates and justifies explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to sharpen communication	Learner given steps and procedures for communication	Learner reports how close to the textbook the conclusions were	Learner reports no conclusions

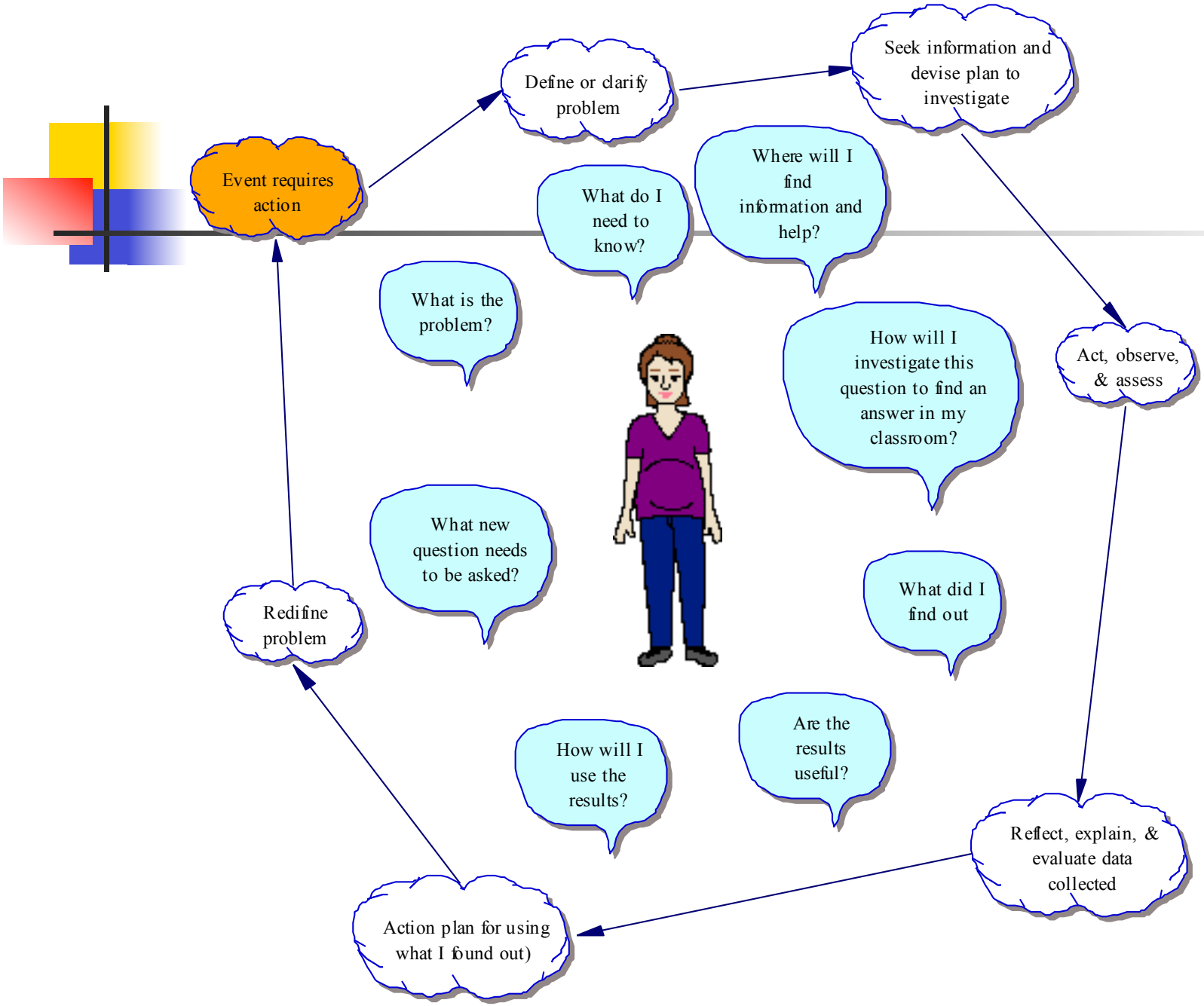
Teacher Action Research

Action Research as a strategy for facilitating change in your physics teaching

the Physics Classroom

Basic Processes of Action Research




Event requires action
Define or clarify problem
Seek information and devise plan to investigate
What do I need to know?
Where will I find information and help?
What is the problem?
How will I investigate this question to find an answer in my classroom?
Act, observe, & assess
What new question needs to be asked?
What did I find out
Redifine problem
How will I use the results?
Are the results useful?
Reflect, explain, & evaluate data collected
Action plan for using what I found out)

Ongoing Action Research Model
(perhaps several cycles for a complex innovation)

A Spiraling Process:

- revise focus (**redefine problem**)
- modify or use new hypotheses (**plan**)
- leading to new actions and new data analysis (**act, observe & assess**)
- revise previous conclusions (**reflect, explain & evaluate**)
- redevelop grounded theory (**understand**)
- etc.... in a continuous spiral leading to self-professional development and change

Questions

- What are "daily researches?"
- How do we get away from (and convince others- parents, administrators) the belief and view that teaching and learning are "a bag of tricks" we perform each class day?
- Not all research is of equal value. What are the characteristics of professional information on teaching and learning that teachers need to consider and evaluate critically.

Questions

- **What is your REAL belief about the statement "Educators who work in … schools remain unconvinced of the efficacy of most of what gets published in scholarly [research] journals in the field of education?" Do you agree? Explain!**
- **How can research be a way of knowing for all of us? In what sense is this possible? Aren't there people who do research and the rest of us don't do research, so we have to trust what they tell us?**

Questions

- **To call yourself an "expert teacher" do you have to be proficient in *searching for*, *reading*, *planning*, *writing*, and *conducting* research in your classroom. Explain why or why not! Must all teachers be proficient? Why?**
- **What is the meaning of "Research provides us with a 'Lens' to consider our practice…"**

Question Summary

- Rate yourself on each of these rubrics in the way you deal with research:
- Lack of time 1 2 3 4 5 Have adequate time
- Impractical 1 2 3 4 5 Practical
- Not Proficient 1 2 3 4 5 Proficient
- Based on these rubrics and other factors do you avoid research in any of its forms (*searching for*, *reading*, *planning*, *writing*, and *conducting)*? Explain! ……

Action Research: Summary

- Note that the question is not, "What should the teacher do next Monday?", but rather "How can you select, adapt, use, or re-conceptualize PTI materials to make learning more productive for students?"
- Action research, also, involves physics teachers in the process of defining, making decisions about, and solving problems leading to their own professional change and growth.

Why Action Research?

- **Educational ideas of others are of little real use on their own**
- **Any "good idea" is a only working hypothesis, not a conclusion. It needs to be tested by you in your physics classroom to gain credibility. Then it becomes our idea that is fully meaningful to us.**
- **Successful change must use our ideas**

Action Research

- **Not a deficit model**
- **Experience is not enough**
- **Creates a climate of search for knowledge. This is more likely to produce change than finding answers.**
- **Not traditional formal research**
- **Self-reflective inquiry to improve teaching**

References

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- Lawson, A. (1995). *Science teaching and the development of reasoning*. Belmont, CA: Wadsworth
- Sagor, R. (2005). *The action research guidebook: A four-step process for educators and school teams. Thousand Oaks CA: Corwin Press.*
- Schmuck, R. (2006). *Practical action research for change.* Thousand Oaks CA: Corwin Press.
- White, R. & Gunstone, R. (1992). *Probing understanding*. New York: Falmer Press.

Action Research Related Web Sites

Developing an Action Research Plan with Examples

http://www.bamaed.ua.edu/sciteach

Web-based Action Research Activities:

http://archon.educ.kent.edu/Oasis/Pubs/0200-08.ht

An Introduction to Action Research

http://www.phy.nau.edu/~danmac/actionrsch.html

Action Research-Linked Sites

http://carbon.cudenver.edu/~myder/itc/act_res.html

Virtual Fly Lab: http://vcourseware3.calstatela.edu/VirtualFlylab/IntroVflyLab.html

Physics Teaching Resource:

Pathway: Physics Teaching Web Advisory. Ask an expert a question.

- ***http://www.physicspathway.org/***
- ***Digital video library for physics teaching at secondary school level***
- ***Four expert physics teachers provide expert advice in short scenes through synthetic interviews - Roberta Lang, Paul Hewitt, Chuck Lang, & Leroy Salary***
- ***Related Videos are also available***

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