

From Teaching to Research on Teaching

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September 20, 2014

e-Seminar on Steps 2 Research, Amal Jyothi College of Engg.

What is Educational Technology

- Technology *For* Education
 - Creation and use of technologies, such as visualizations, and technology tools, such as Wiki and Moodle, in the teaching-learning process.
- Technology *Of* Education
 - Creation and use of strategies, such as Peer-Instruction and Think-Pair-Share, for facilitating students' learning and engagement.

What is Research in ET?

We are **ET Practitioners** when we:

- teach students; facilitate their learning.
- think about improving students' learning, interest in the subject, engagement in class, ...
- come up with ideas for doing the above.

We become **ET Researchers** when we:

- scientifically investigate the worth of our ideas.
- conduct systematic studies to get data about whether our ideas are working.
- provide evidence to support our conclusions.

Why should you bother with ET research?

- You are anyway working on the "problems" arising in your class; You are coming up with solutions
 - Why not systematically implement solutions to improve your teaching
 - Why not go the extra steps required for closure
- Some benefits of closure - doing a systematic study using ET research methods, followed by writing a paper - are:
 - Others could adopt your solutions.
 - You get a publication to your name.
 - Your skill in applying the scientific method in other areas of research will also improve.

This session is about

Going from
being an ET Practitioner
towards
becoming an ET Researcher

Action Research:

Conducting research on one's practice

Action Research is “a disciplined process of inquiry conducted *by* and *for* those taking the action. The primary reason for engaging in action research is to assist the ‘actor’ in improving and/or refining his or her action.”

Guiding School Improvement with Action Research, Richard Sagor, ASCD.

<http://www.ascd.org/publications/books/100047/chapters/What-Is-Action-Research%C2%A2.aspx>

Cycle of Action Research



Steps of Action Research

Selecting a focus

Clarifying theories

Identifying research questions

Collecting data

Analyzing data

Reporting results

Taking informed action

Learning objectives of this session

At the end of this session, you will be able to:

- Write some Research Questions for your innovative teaching idea.
- State the commonly used metrics for evaluation of studies on Technology Enabled Learning.
- Identify the type of instruments required to evaluate your idea.

Activity - Think-Pair-Share

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Think: *Write one innovative teaching idea you have implemented in your class, preferably using a technology tool.*

This idea should not only contain: giving a lecture or showing ppt slides

Specifically write :

1. What the teacher does
2. What the students do
3. What you expect to improve by implementing your idea
(~3 minutes)

Activity - Think-Pair-Share

Pair – turn to your neighbour.

1. Share your answer with your neighbour.
2. Along with your neighbour, come up with what could measure to indicate that your idea is successful.

Write statements like:

I think my idea is ‘successful’ **if I find that**

My students are doing _____

My students are feeling _____

3. Select any one statement and determine how you will measure the extent of the ‘success’.

(~7 minutes).

Activity - Think-Pair-Share

Share: Share your answer with your colleagues at Amal Jyothi. Mention both 'what is to be measured' and 'how it is to be measured'.
(~3 minutes).

Coordinator: Please share the 3 most common answers.
(~2 minutes).

Identifying Research Questions

Research Questions (RQs)

A research study contains *research questions*, and its answers, accompanied by evidence.

Example: If you have identified a *teaching-learning problem*, and come up with a *solution* for that problem, the *research questions* in your research study could be about - *how well does your solution address the problem.*

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~~NOT an RQ: Should one use animations in primary school classrooms?~~

RQ: Are animations more effective than still visuals for conceptual understanding of electromagnetic fields?

RQs - Examples

Study: Implemented Think-Pair-Share active learning strategy in a Programming Course.

Research Questions

- How much student engagement occurs in the Think-Pair-Share activity?
- How does the amount of engagement change as the activity progresses?
- Do TPS activities lead to increased conceptual understanding and application of CS1 concepts?

Check criteria of Research Questions:

- 1) Expresses relation between variables, in a specific context.
- 2) Stated clearly in question form, not as a statement.
- 3) RQ must *imply* possibilities of empirical testing

RQs - Examples

Study: Teacher showed part of a visualization (animation), asked students to predict next step, then compared prediction with rest of visualization.

Research questions:

- Does prediction activity with a visualization lead to higher levels of learning than simply viewing the visualization?
- What are student perceptions about learning from visualization with the strategy used?
- What are the differences in learning and perceptions in high achievers compared to low achievers?

RQs - Examples

Study: Students used Blender (3D animation s/w) in a lab in a computer graphics course.

Research questions:

- Does a 3-hour Blender training improve the mental rotation ability of first year undergraduate engineering students?
- Does a 3-hour Blender-3D training module motivate students to learn Computer Graphics concepts?

Think-Pair-Share Activity – Rewrite as RQ

Think:

1. Revisit your answer to the Think-Pair-Share activity
2. Write one RQ for your ET research study.
 - Note that this should be a ‘Question’, not a ‘Statement’.

Pair:

1. Confirm that the RQ is phrased as a question. If not, help your colleague write it as an RQ.

Share

1. Participants - Convey your RQs to your colleagues.
2. Co-ordinator – Please share over A-view

TEL Metrics – What to measure?

An ET research study based on your idea can have different goals. You can focus on one or two of:

- **Effectiveness** - improving learning of concepts or skills.
- **Attractiveness** - enhancing students' engagement, motivation, confidence, affective states.
- **Accessibility** - scaling a solution to larger groups, different types of learners, different contexts.
- **Efficiency** - saving time (individual or for a group), or money or other resources in the system.

Caution: Do not attempt all four metrics in the same study.

Activity - Poll

Question: Revisit the RQ that you wrote in the previous activity. Which TEL metric does it best correspond to?

1. Effectiveness – Improving learning.
2. Attractiveness – Enhancing engagement, etc.
3. Accessibility - Scaling to different scenarios.
4. Efficiency – Saving time or resources.

Participants: Vote on the question above.

Coordinators: Convey the majority vote.

Instruments – How to measure?

- **Tests** – are commonly used instruments for measuring the TEL metric of Effectiveness - improvement in learning of concepts or skills. See example on next slide for some Do's and Don'ts.
- **Survey Questionnaires** – are commonly used instruments for measuring the TEL metric of Attractiveness - enhancement in students' engagement, motivation, confidence, affective states.
- **Focus group interviews, Observation protocols, and other instruments** – are beyond the scope of this workshop!

Example – Measuring learning of concept

Effectiveness of learning	Chosen metric
Improvement of learning of specific concept	Evidence needed
Performance on a test related to the concept before and after the treatment	What data to collect
Standardized test having conceptual and reasoning questions related to the concept.	Chosen instrument
Use a typical final exam containing only recall or describe questions.	<i>What NOT to do</i>

Example – Measuring learning of skill

Effectiveness of learning	Chosen metric
Improvement of a skill such as programming ability	Evidence needed
Performance on a programming or debugging question	What data to collect
Ask students to write a program to solve a specific program; give an erroneous program and ask students to debug the code till it gives a desired output	How to measure
Analyze number of errors in the program, classify them as syntax errors and logical errors	How to analyze
Ask Recall or understand level questions such as “What is a variable?” .	<i>What NOT to do</i>

Example – Measuring student engagement

Attractiveness	Chosen metric
Student engagement	Evidence needed
Students' perception of their interest in the course format; Other measurements are attendance and participation rates, students' time-on-task.	What data to collect
Questionnaire to measure perception of interest, for example on a Likert scale. Observations for time-on-task.	How to measure
Frequency distribution of Likert scores (Number of Strongly Agree ... Strongly Disagree)	How to analyze

Example - Constructing perception surveys

Instead Do	Don't
Ask questions related to what you want to measure – for example, students' perception of engagement or their own learning	Do not simply ask – Did you like / dislike it?
Ask many specific questions related to what you want to measure	Do not ask a single leading question - Is the method interesting?
Preferably use a scale / rating / ranking, (you can include additional open questions to support rating questions)	Do not only include open descriptive questions (analysis is hard)

Activity – Poll: Is this an ET research study

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Your colleague says: “I will prepare interactive multimedia content and animated videos. Using Moodle, the student can access the content in order to make interactive session. The student will be more interested and interactive. Animated videos will be persisted in their mind. The concept will be easily understandable.”

Is this an ET research study?

1. Yes.
2. No.

Participants: Vote on the question above.

Coordinators: Convey the majority vote.

Summary - 1

Mere development of instructional material or strategy
is NOT a ET research paper
even if the material is based on an innovative idea.

To be considered as a research paper, you need to show that
the material or strategy has resulted in improvement in student
learning or engagement.

How to progress this idea into a research study

Need to show evidence that the material has resulted in improvement in student learning or engagement.

For example -

- I will give a quiz to test students' understanding on a concept learnt using multimedia, and compare it with their understanding on a similar concept learnt using traditional material such as a textbook.
- I will prepare a questionnaire that asks students their preference of using multimedia vs. traditional (print) material, and their reasons of doing so.

Activity – Poll: Is this an ET research study

Your colleague says: “The purpose of this study is to use Moodle, in an engg course and study the motivation behind its use by participants. Activities such as presenting information, managing course material, and evaluating student work through Moodle quizzes, all were done using Moodle. Instructors were asked the benefits and barriers to using Moodle.”

Is this an ET research study?

1. Yes.
2. No.

Participants: Vote on the question above.

Coordinators: Convey the majority vote.

Summary - 2

Use of an ET tool in a routine manner is NOT a research paper.

To be considered as an acceptable research paper, you need to implement an innovative method of using the tool to achieve a teaching-learning goal.

Example: Use Moodle to create a game that allows student to learn a concept; teacher can check how much collaboration occurs.

Overall Summary

Recall key points of this session:

What is not ET research?

- Mere development of instructional material is not ET research.
- Use of an ET tool in a routine manner is not ET research.
- A report of application of an ET strategy is not ET research.

What are some features of ET research?

- Identify Research *Questions* of your study.
- Use established TEL metrics for evaluation of your study.
- Gather data using appropriate instruments – Tests, Surveys, etc.
- Go at least one step beyond “the routine” (How? Read papers!)

What is a research paper?

**Examine papers published in 'reputed'
ET conferences and journals.**

Example . How we teach impacts student learning: Peer Instruction vs. Lecture in CS0 (programming course), *SIGCSE 2012*

Read the following abstract of the paper:

We look at the impact on student learning of the pedagogical approach in which a class is taught. We compare two sections of a non-majors programming course offered in the same term, by the same instructor, covering the same content and utilizing the same book, labs and exams. One section was taught using standard lecture practices including lecture from slides, live coding and weekly quizzes. The other section was taught using the Peer Instruction (PI) method that actively engages students in constructing their own learning, instead of absorbing understanding from the instructor's explanations. Using a factorial analysis of variance, we find that students in the Peer Instruction section score an average 5.7% higher than in the standard lecture practices section.

Example. How we teach impacts student learning: Peer Instruction vs. Lecture in CS0 (programming course), *SIGCSE 2012*

Precise problem description

We look at the [impact on student learning of the pedagogical approach](#) in which a class is taught. We compare two sections of a non-majors programming course offered in the same term, by the same instructor, covering the same content and utilizing the same book, labs and exams. One section was taught using standard lecture practices including lecture from slides, live coding and weekly quizzes. The other section was taught using the Peer Instruction (PI) method that actively engages students in constructing their own learning, instead of absorbing understanding from the instructor's explanations. Using a factorial analysis of variance, we find that students in the Peer Instruction section score an average 5.7% higher than in the standard lecture practices section in the final exam.

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Novel solution approach

We look at the impact on student learning of the pedagogical approach in which a class is taught. We compare two sections of a non-majors programming course offered in the same term, by the same instructor, covering the same content and utilizing the same book, labs and exams. One section was taught using standard lecture practices including lecture from slides, live coding and weekly quizzes. The other section was taught using the [Peer Instruction \(PI\)](#) method that actively engages students in constructing their own learning, instead of absorbing understanding from the instructor's explanations. Using a factorial analysis of variance, we find that students in the Peer Instruction section score an average 5.7% higher than in the standard lecture practices section in the final exam.

Example 1. How we teach impacts student learning: Peer Instruction vs. Lecture in CS0 (programming course), *SIGCSE 2012*

Sound procedure

We look at the impact on student learning of the pedagogical approach in which a class is taught. We compare two sections of a non-majors programming course offered in the same term, by the same instructor, covering the same content and utilizing the same book, labs and exams. One section was taught using standard lecture practices including lecture from slides, live coding and weekly quizzes. The other section was taught using the Peer Instruction (PI) method that actively engages students in constructing their own learning, instead of absorbing understanding from the instructor's explanations. Using a factorial analysis of variance, we find that students in the Peer Instruction section score an average 5.7% higher than in the standard lecture practices section in the final exam.

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Evaluation of solution

What next?

Those interested in learning more about ET research should:

- Attend the IEEE conference on Technology for Education - **T4E 2014** - at Amrita University, Kollam, Dec 18-21, 2014.

Those interested in executing their idea and carrying out the corresponding ET research study should:

- Write a research paper on your idea for **T4E 2015**.
- **Download and Use Templates:** www.et.iitb.ac.in/resouces