Analyzing Student Laboratory Reports*

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Outline

Importance of Laboratory Reports

Setting

Design

Results & Discussions

Questions & Future Study

Importance of Laboratory Reports

- Academia
  - At most universities, students in the introductory physics laboratories are expected to write reports to communicate the information interpreted from the experimental data that they have gathered
- Industry
  - Sought-after skills by employers
    - Ability to formulate writing of technical data and analyses
    - Ability to communicate effectively through this writing
- University of Minnesota
  - An important part of problem-solving-based instructional strategy
    - Learning through synthesis of information
    - Communication of understanding
    - Documentation of solving laboratory problems
    - Grade

Setting

- Lecture
  - ~200 students / 1 lecturer
  - 3 hours / week
- Recitation
  - 15 students / section
  - 1 hour / week
- Laboratory
  - 15 students / section
  - 2 hours / week

★ Note:

All parts of the course are integrated such that the problems in lab and recitation are concurrent with the topics being covered in lecture

- Laboratory
  - problem-solving-based
  - cooperative group (3 students per group)
  - each student hands in one laboratory report
  - reports consist of different problems
  - TA assigns each student a different problem at the end of each unit
    - no one knows which problems will be assigned ahead of time
  - TA grades the reports
    - report grade = 60% of lab grade
    - lab grade = 15% of course grade

- Students
  - 65% Freshman
  - 75% Engineering
  - 79% Male
  - 45% First college science course

- TAs
  - 1st & 2nd year graduate students
  - First time teaching a class
  - 2 week Orientation & Weekly Seminar
  - Weekly teaching team meetings

- Workshop on evaluating written communication

  - Introduction to general criteria
  - Individual grading of sample student laboratory reports
  - Whole group discussion on personal grading schemes
  - Consensus on grading criteria
  - Criteria for Evaluating Written Communication

Guideline for grading laboratory reports

Problem Report:	**Score**
ORGANIZATION (clear and readable; correct grammar and spelling; section headings provided; physics stated correctly)	
DATA AND DATA TABLES (GROUP PREDICTIONS) (clear and readable; units and assigned uncertainties clearly stated)	
RESULTS (results clearly indicated; correct, logical, and well-organized calculations with uncertainties indicated; scales, labels and uncertainties on graphs; physics stated correctly)	
CONCLUSIONS (comparison to prediction & theory discussed with physics stated correctly ; possible sources of uncertainties identified; attention called to experimental problems)	

- Reports:
  - Modeled on short technical memos
  - On the order of two to three pages
  - Requires approximately two to three hours for grading by the TA
    - laboratories restricted to 15 students per section

Design

- Introductory calculus-based mechanics laboratory
- Selected TA (first year) asked to copy all reports before grading
- Sample consisted of 15 Students followed through a 15-week semester
- Laboratory reports analyzed based on 5 criteria designed for evaluating written communication

- Evaluating Laboratory Reports for Communication
  - Dr. Lee-Ann Kastman Breuch
    - Dept. Of Rhetoric, U of MN

- Writing Across the Curriculum
  - U of MN (Writing Intensive Course)
  - Writing:
    - a way of learning
    - important for learning technical content
    - not separable from content
    - varies from situation to situation
    - students can practice writing documents that are central to their major/program of study

- Criteria
  - Content: What is the subject? What information needs to be included?
  - Context: What is expected in the discipline for this type of document?
  - Audience: To whom is the document written? How will it be used?
  - Organization: How can the information be best organized? Can the information be divided into sections?
  - Support: What details, facts, and evidence can be used to illustrate main points?

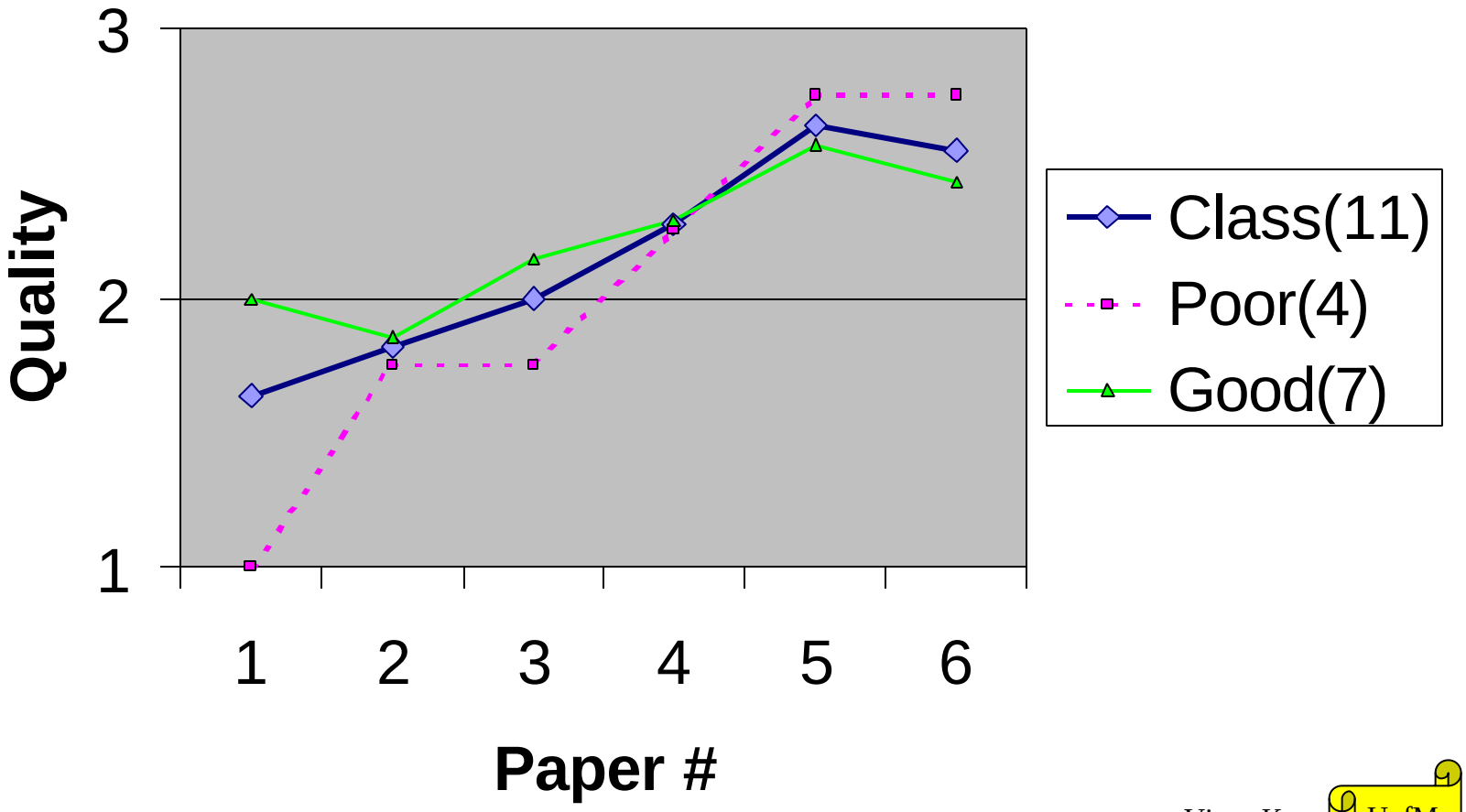
Example of quality levels - Content

	Excellent	Good	Poor
Addresses content accurately and thoroughly	Includes accurate and complete technical information, including formulas, explanations, theorems, and data.	Includes accurate technical information, but has missed some important information.	Does not include accurate or complete information.
Score	3	2	1

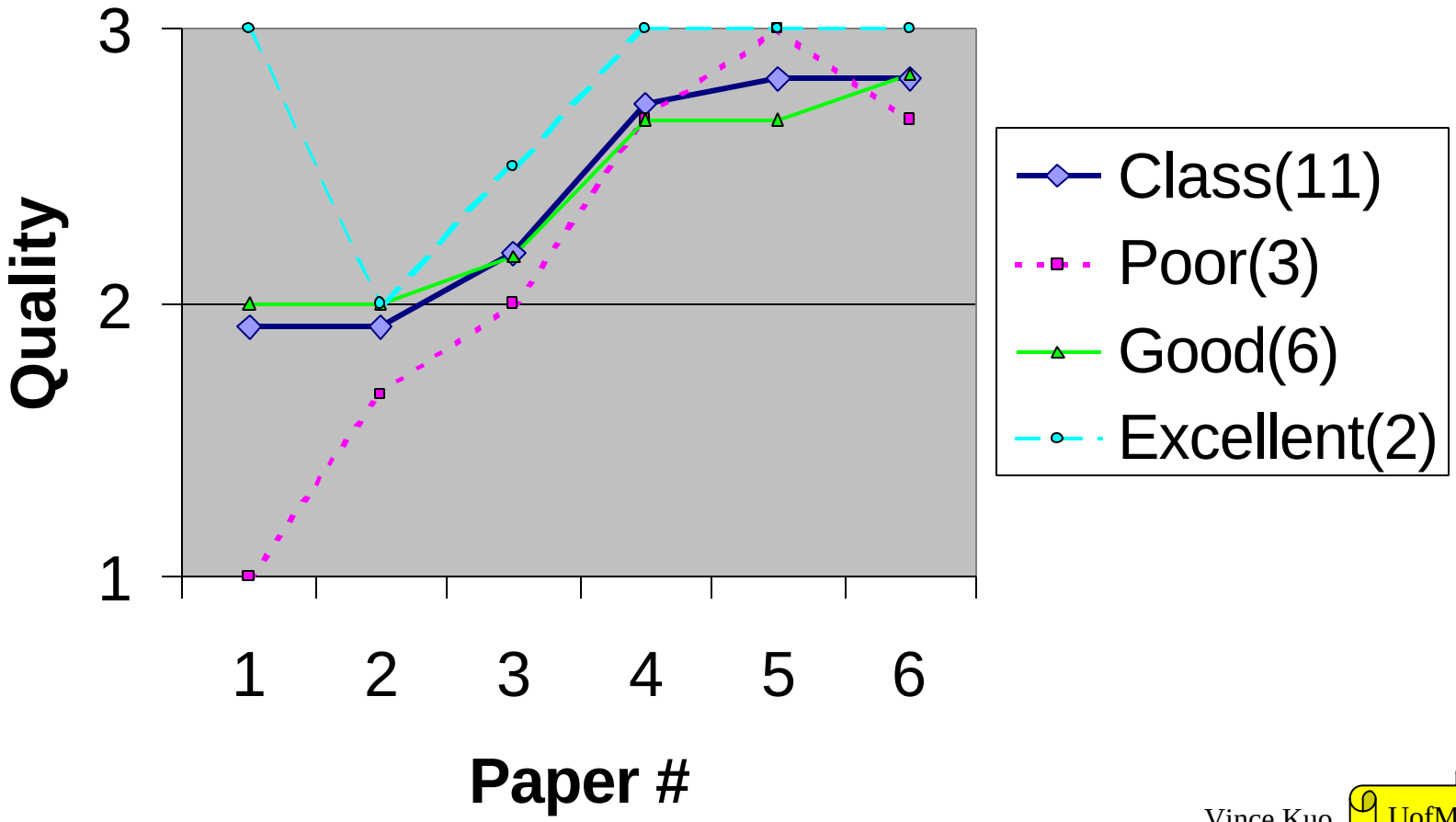
Results

- One class of 15 students
  - 11 of which had all 6 laboratory reports from the entire 15-week semester (n = 11)
- Each student is placed into one of three groups based on the grade of the first report
  - Poor
  - Good
  - Excellent

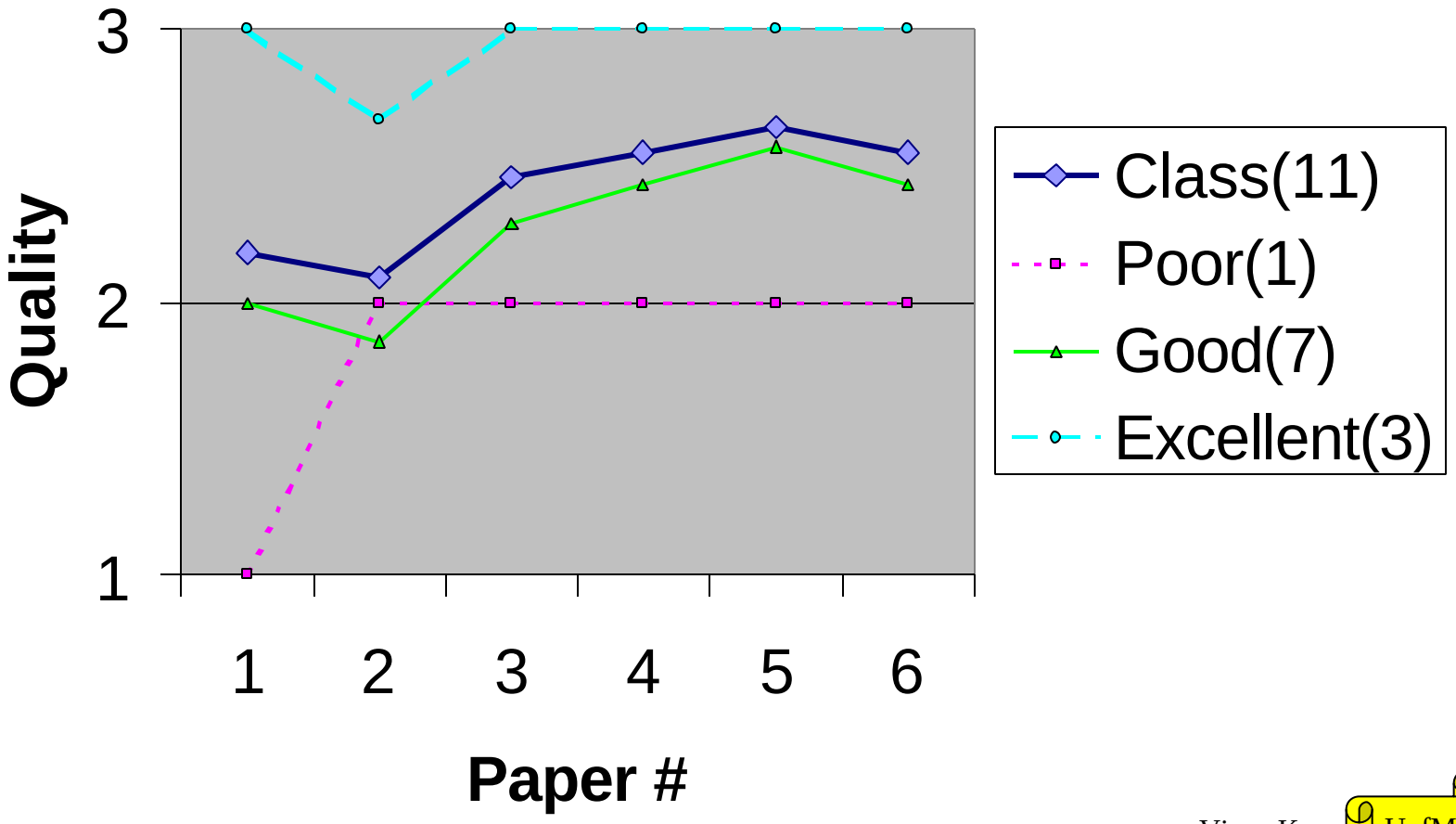
Content (Averages)



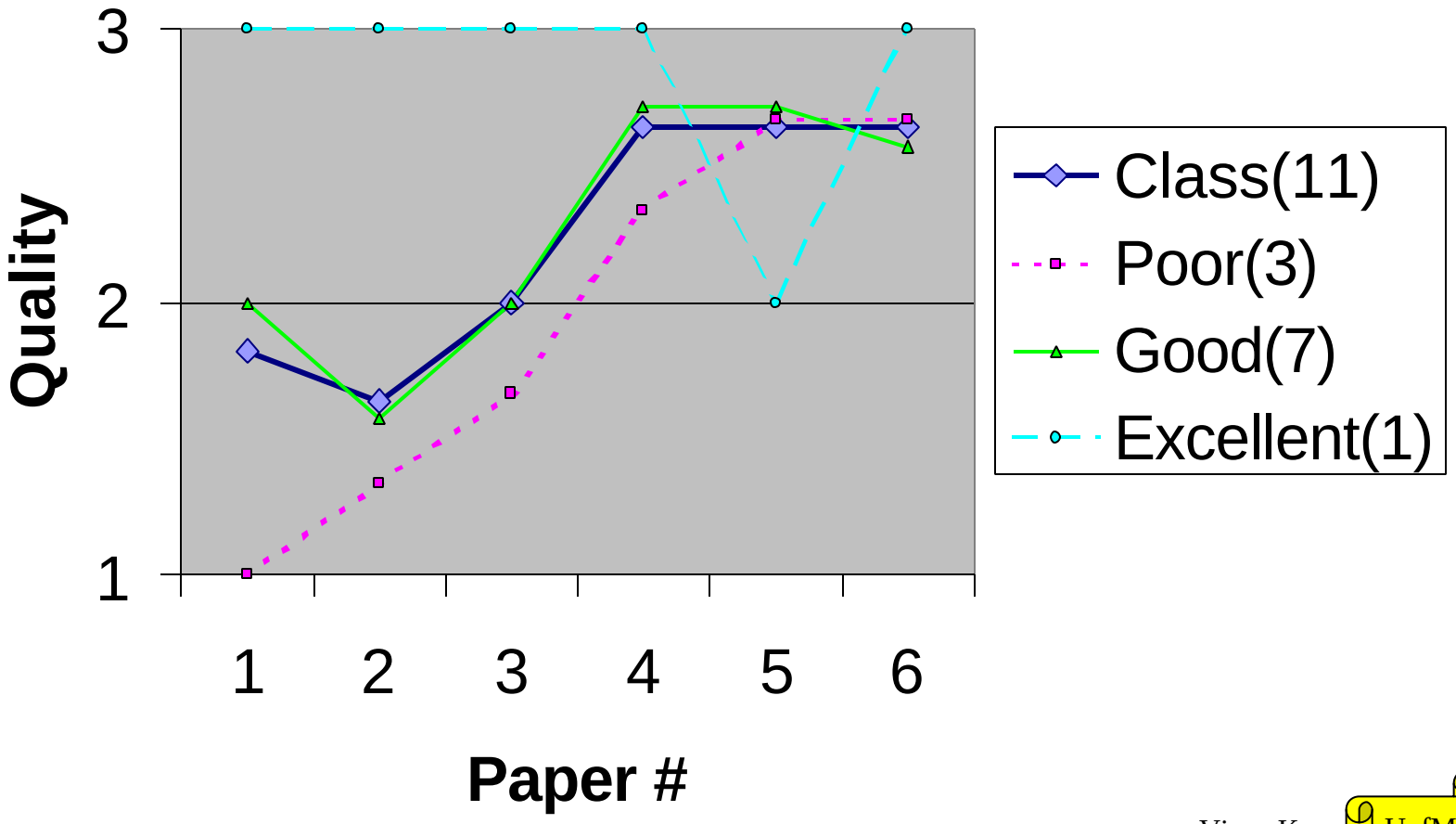
Context (Averages)



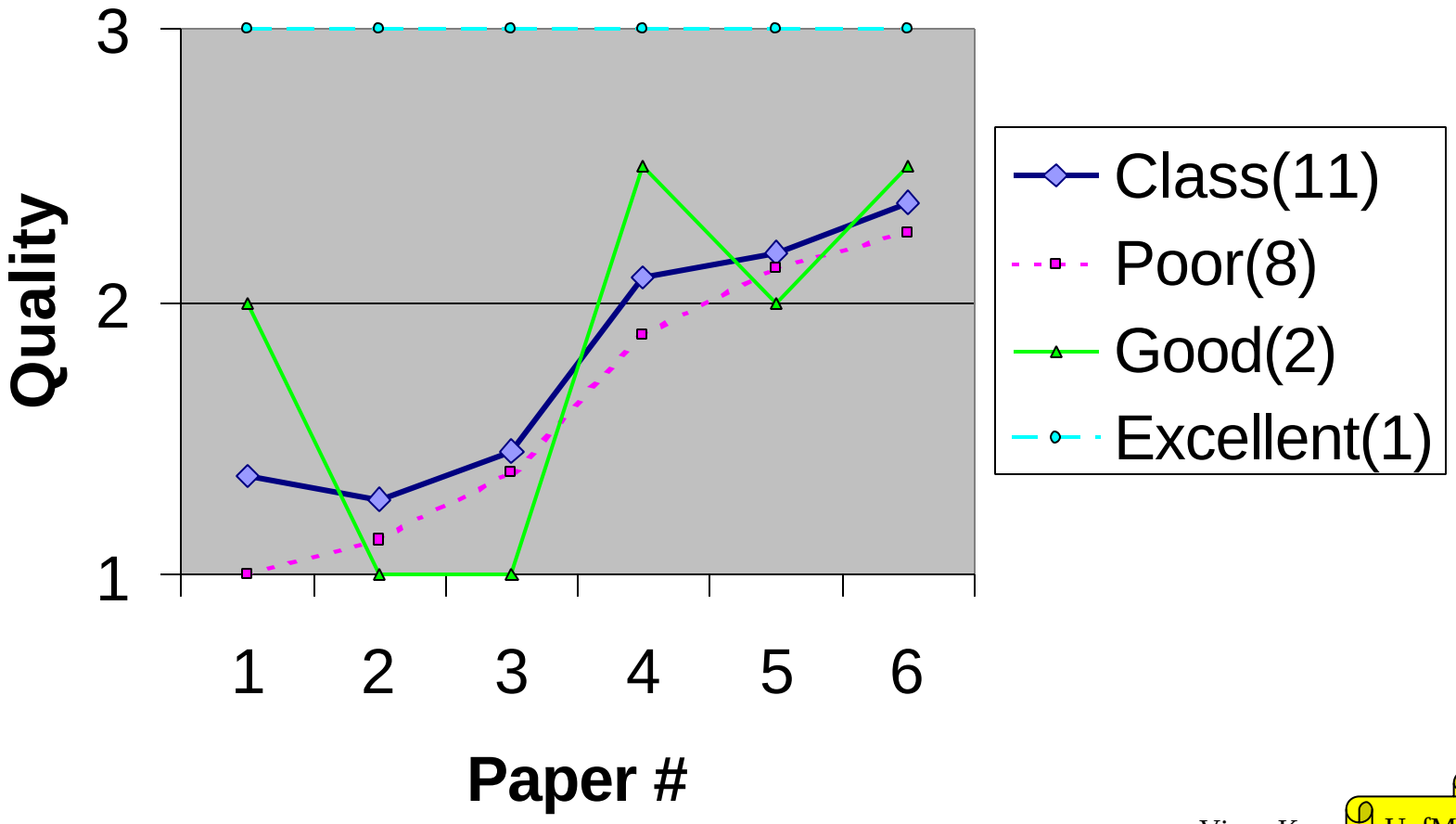
Audience (Averages)



Organization (Averages)



Support (Averages)



Discussions

- Students of all ability levels showed signs of improvement in each of the criteria
  - Except for those students that were initially-excellent, every students reached approximately the same quality by the end of the 15-week semester

- Identifiable increases in quality apparent by 3rd or 4th report
  - content, context, audience, & organization
- Slower increases in quality of support
  - majority of students only slightly higher than "good"

- Writings rated not simply as physics reports, but also as technical communications

  – What does that mean?
    - Physics can be wrong and still achieve excellent rating in other criteria
  – Is that useful?
    - Effective communication enables TAs to easily identify where students need help
    - Implement more effective coaching strategies

Questions

- Have we helped?
- Have we attained the goals set by WAC?
- Can we do better?

Future Study

- Larger sample
- Corresponding Laboratory grades
  - Possible modification to actual grading guidelines
  - More comprehensive integration of WAC initiative and our instructional pedagogy
- Effect of report writing on students' achievements in the course(?)
- Others ...

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