

Aropä and PeerWise: tools for collaborative learning

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- A paper folding entrée
- Did anyone. . .
- What we know about learning
- Why change is needed
- Where technology comes in
- Overview of tools we have developed

Peer Assessment

PeerWise (Paul Denny)

Looking ahead

Closing remarks

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Entrée Grenouille Origami

Main course Aropä and PeerWise

Dessert (Digital) ink

A paper folding entrée

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- pay attention; this material will be in the exam!

A paper folding entrée

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Did anyone...

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- know exactly what to do from the (excellent!) instructions?

OR

- Did you learn something by **doing** the paper folding?
- Did you get help from the **person next to you**?
- Maybe you helped someone (lucky them!). Can you imagine **learning anything yourself** from doing this tutoring?

What we know about learning

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- In traditional lecturing: the lecturer **broadcasts** the knowledge and allocates grades in relation to the fidelity of the **echos**
- A shallow learner *only learns how to echo*
- A deep learner does more: **constructs, relates** and **shares** knowledge.
- What distinguishes a deep learner from an echoer?
 - Ownership of knowledge
 - Creating connections
 - Sharing understanding
 - . . .

Why change is needed

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The assumptions that underlie traditional lecturing are no longer valid:

- knowledge is stable? (no, knowledge is **dynamic**)
- possession of knowledge is key? (no, the ability to **evaluate** and **synthesise** knowledge is key)
- work is individual? (no, work is **collaborative**)
- teacher is the authority? (but authority undermines deep learning)

Where technology comes in

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- One-on-one teaching is the “gold standard”

However:

- a large class is a powerful resource
- web-based software can harness this collective intellectual capacity
- online interaction frees students from constraints of time and place, and is scalable

Also,

- doing it online allows the instructor to monitor student activity
- increasingly, paper is making way to virtual artifacts; e.g. interactive models, podcasts, video recordings, . . .

Overview of tools we have developed

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PeerWise (Paul Denny)

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Aropä Student peer assessment

- Allows routine use even in large, introductory classes

PeerWise (Paul Denny) Students co-author a multi-choice question bank

- Large drill-and-test database created over the duration of the course
- Social network: provide feedback, rate each others' questions

Penmarked (Beryl Plimmer) Document annotation using digital ink

- Feedback is richer, easier

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Peer Assessment

- Traditional assignment
- Peer-assessed assignment
- What changes?
- Aropä project
- Main screen
- Grading rubrics
- Student feedback
- What did you like most?
- Dislikes
- Can students mark accurately?

PeerWise (Paul Denny)

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Peer Assessment

Traditional assignment

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Peer Assessment

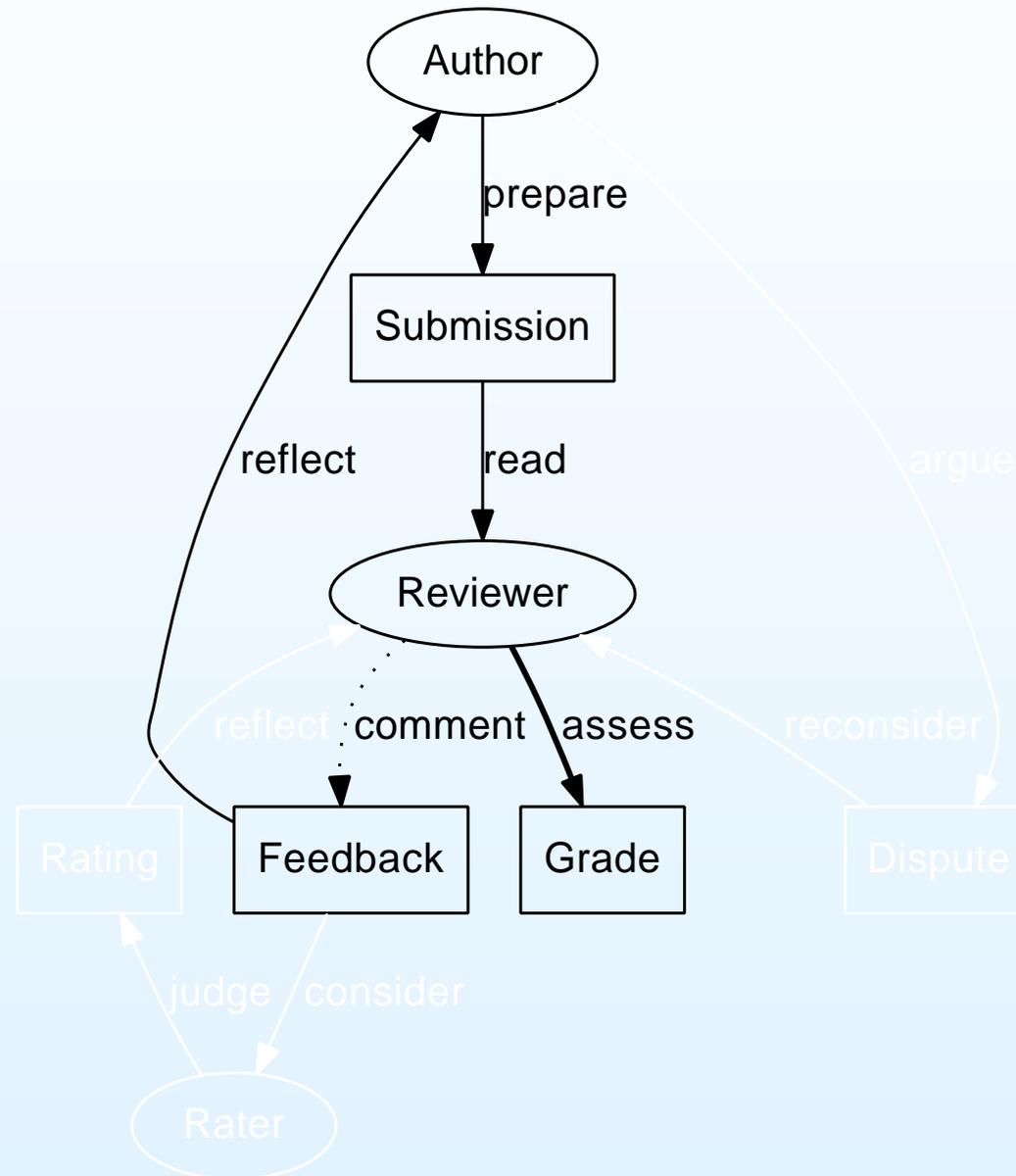
● Traditional assignment

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Peer-assessed assignment

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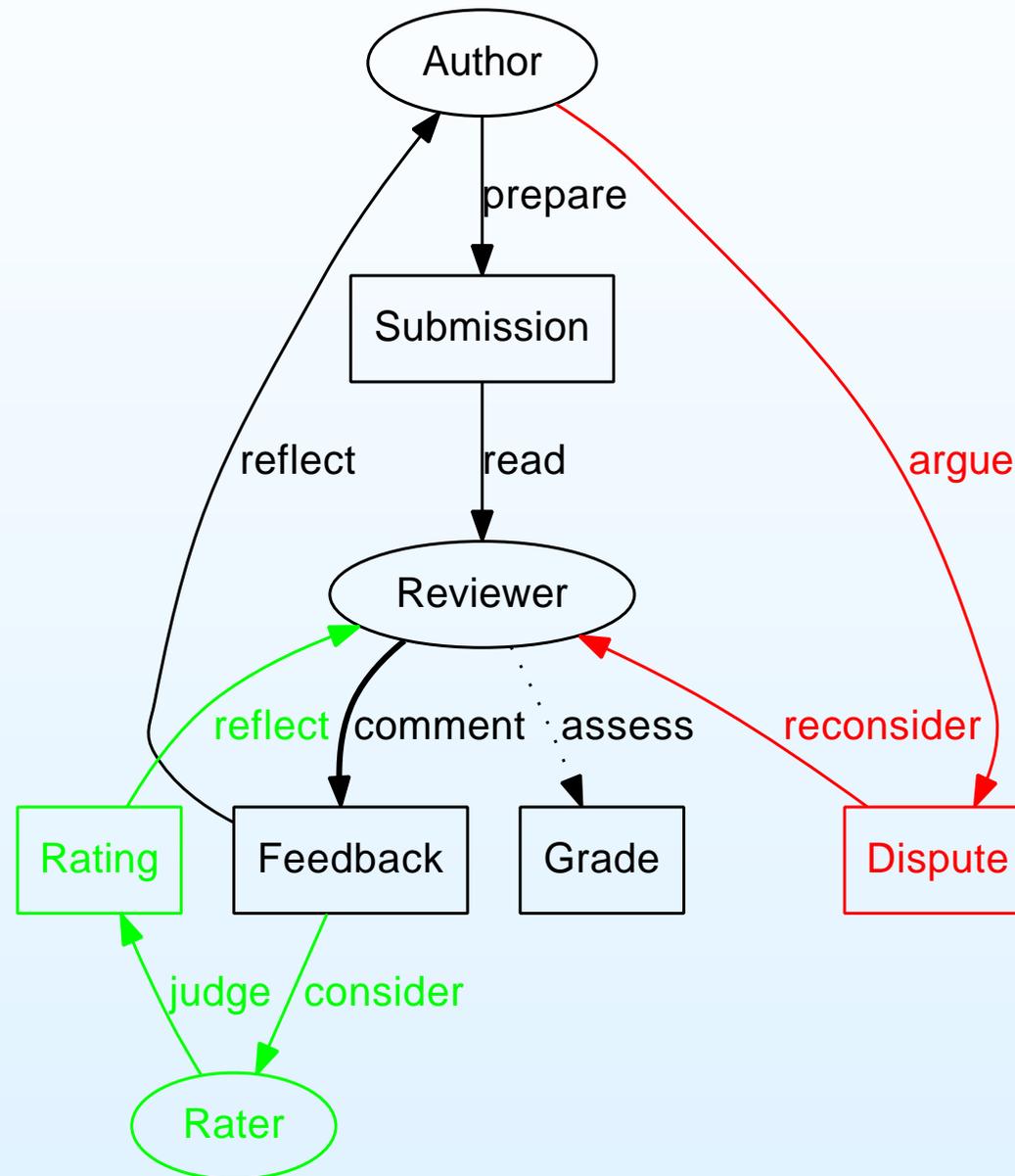
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What changes?

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PeerWise (Paul Denny)

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- Increased **involvement** by student (time on task, time engaged with task)
- Greater **variety** of tasks undertaken by student
- **Reduced delay** between authorship and feedback
- Increased **volume** and **diversity** of feedback
- More opportunities for **reflection**
- Raised awareness of own **relative performance**
- Change in **power relations** between author and reviewer, student and lecturer
- Greater **social involvement**
- **Rich trace** of student performance
- Assessment becomes a part of the learning process
- Department marking budget available for redistributing to remedial tutoring, etc.

Aropä project

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PeerWise (Paul Denny)

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- Aropä project running since 2002, aimed at making peer assessment a routine activity throughout the curriculum
- Web-based support tool for managing submission, allocation of reviews, review entry, distributing feedback, monitoring progress, and aggregating marks.
- Wide range of courses: Academic Practice, Business, Civil Engineering, Commercial Law, Computer Science, English, Electrical Engineering, Environmental Science, Information Management, Medical Science, Pharmacology, and Software Engineering.
- Wide range of outputs: reports, essays, presentations, digital photographs, posters, legal cases.

Main screen

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PeerWise (Paul Denny)

Looking ahead

Closing remarks



You are logged in as "A Student".

[Logout](#) [Home](#) [Change Password](#)

Allocations

"Barney's Bikes Ltd." (Reviews due by 5pm May 21, 2008)

Allocation 1	View submission	Re-mark	View last mark
Allocation 2	View submission	mark	
Allocation 3	View submission		
Allocation 4	View submission		

Reviewer feedback

- Feedback for "Batou Ltd v. Motoko Ltd"
- Feedback for "Batou Ltd v Gundam Corporation"
- Feedback for "Barney's Bikes Ltd."

Grading rubrics

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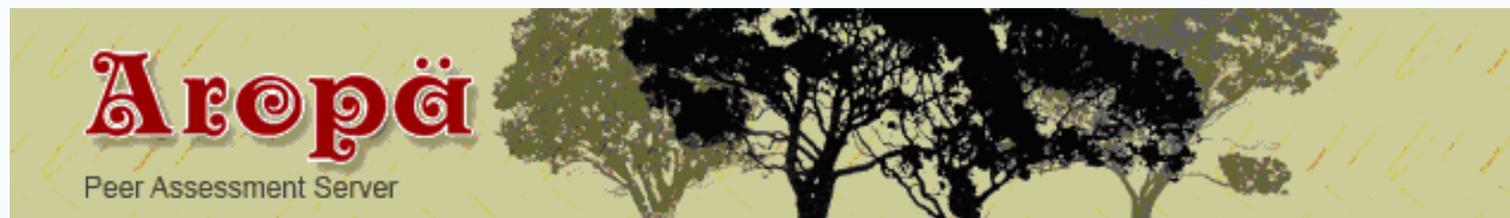
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Grading rubric for CIVIL 408A Annotated Bibliographies Document

Title of research topic + An introductory paragraph to the 6 selected articles taken from at least 3 different kinds of source.

- The research title and introductory paragraph comply with the criteria and are clearly stated.
- The research title and introductory paragraph comply with the criteria and are stated.
- The research title and introductory paragraph comply with the criteria and are poorly stated.
- The research title and introductory paragraph do not comply with the criteria. They have not been stated.

Summary of the aims, main points and conclusion for each article + Evaluation of the relevance/usefulness of each article

- The aims, main points and conclusion of have been clearly summarised; At least 6 reference articles have been critically evaluated based on the usefulness or relevance to the research topic.
- The aims, main points and conclusion of have been summarised; At least 4 to 5 reference articles have been critically evaluated based on the usefulness or relevance to the research topic.

Grading rubrics

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Draft assessment exercise

Write at least one sentence in response to each of the five questions below (making 300 words altogether) with regard to the draft essay.

1. What is the issue that the draft is addressing. Is it interesting? Do you care about it?

[Write your response to the issue in the text box below](#) (hidden; click here to show)

2. Say what you think the argument of the draft is. If the argument is not clear, suggest what a possible argument might be.

[State the argument in the text box below](#) (hidden; click here to show)

3. What kinds of reasons, which includes kinds of evidence, does the writer offer to support the argument? You might like to point out the obvious warrant for the argument, if there is one.

[Give the reasons in the text box below](#) (hidden; click here to show)

4. Suggest a counterargument to the argument of the draft. This comment may, alternatively, point out unexamined assumptions and/or missing or unacknowledged evidence.

[Give the counterargument in the text box below](#) (hidden; click here to show)

5. Identify a characteristic sentence of the writer. Say what you think is good about this sentence, or how this sentence can be improved (your chosen sentence may simply identify a repeated writing fault).

[Identify and comment on the sentence in the text box below](#) (hidden; click here to show)

Student feedback

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Closing remarks

- Anxiety in first-time participants, but
 - High levels of participation (median > 90%)
- Feedback received is not highly valued, but
 - Students see benefit in writing reviews
 - Also value seeing other student work
 - Benefit perceived in reviewing both exemplary and weak work

J. Hamer, C. Kell, and F. Spence. Peer assessment using Aropä. In Samuel Mann and Simon, eds., *ACE'07: Ninth Australasian Computing Education Conference* (66) 43–54, Ballarat, Victoria, February 2007. Australian Computer Society.

What did you like most?

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- Can students mark accurately?

PeerWise (Paul Denny)

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Closing remarks

- *“I liked the way that reading other students work sometimes helped me realise the mistakes in my own work.”*
- *“It was interesting and beneficial to see what others had written in their answers. Not only did it expand my knowledge of the subject matter but it gave me a better understanding of what makes a good answer”*
- *“I really enjoyed being able to see and comment on other students’ work. It has given me a new perspective on the way I read my own work. I have a tendency to throw all my thoughts into an assignment and expect the marker to understand what I mean by wading through it. I think I am already trying to communicate more effectively by being more concise.”*

Dislikes

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PeerWise (Paul Denny)

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Closing remarks

- *“Students do not mark properly, some of them don’t even read assignments properly I gathered that from comments I received.”*
- *“Some people can have different point of views, some people might even have unique view (by thinking into details. . . while others are just ignoring some facts) and hence produce different marking results.”*
- *“This process can be fairly time consuming and if, say, it was to be appended to every assignment, it would add significantly to workload, unless there was a corresponding reduction in asst scope.”*

Can students mark accurately?

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- **Can students mark accurately?**

PeerWise (Paul Denny)

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Closing remarks

- Five assignments from two large classes
- Compared peer marks with tutor marks (pairwise comparison)
- 10,335 reviews in total
- Peer mean: 84.7, tutor mean: 85.8 (slight tendency to undermark)
- Correlation: **71%**
- (the final mark correlation, after taking the weighted average of all the reviews, is typically higher)
- (additional features provided to identify and reduce the influence of any “rogue” markers)

J. Hamer, H. Purchase, A. Luxton-Reilly and P. Denny. Quality of Peer Assessment in CS1. *ICER'09: 5th International Computing Education Research Workshop*, (to appear), Berkeley, California, 2009.

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PeerWise (Paul Denny)

- Student generated MCQ bank
- After answering a question
- Explanations and discussion
- Research results
- What do students think?
- Survey results
- Students use the system voluntarily
- Students rate questions accurately
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- Broad coverage of course topics
- PeerWise use improves exam performance

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PeerWise (Paul Denny)

Student generated MCQ bank

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Closing remarks

- Student write MCQ stem and distractors, plus explanation
- Can answer MCQs posted by other students
- Discussion forum with each question
- Rate for quality, difficulty
- Leaderboards: highest rated, most contributed, most answered

After answering a question

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PeerWise

CompSci 111 (2008 S2)

You are logged in as **andrew**. [Logout](#)

[Home](#) | [Main menu](#) > [Unanswered questions](#) > [Rate question](#)

✓ **CORRECT**

✓ Your answer agrees with the answer suggested by the author, and is the most popular answer

Question:

This question has been answered by 20 people and has an average rating of 3.5385 (based on 13 ratings)

What does EPROM stand for?

Alternatives

You selected C when answering this question
The contributor suggests C is the correct option

OPTION	ALTERNATIVE	RESPONSES
A	Electrical Programmable Read Only Memory	1 (5.00%)
B	Easy Processing Read Only Memory	4 (20.00%)
C	Erasable Programmable Read Only Memory	11 (55.00%)
D	Electrical Processing Read Only Memory	2 (10.00%)
E	Erasable Processing Read Only Memory	2 (10.00%)

Answers are not checked by the instructor, but the most popular answer provides a cross-check

After answering, overall responses are shown

Explanations and discussion

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When dealing with arrays, there are a few things to remember. 1) When created, the value used inside the square brackets indicates the length of the array, or how many elements it can contain. The length counts from a starting point of 1. The INDEX however, begins at 0. Meaning that in this case, where we created our integer array with a length of 15, the valid indices are 0 to 14. (C) is the correct answer because: `i = array.length - 1`, evaluates to 14. The last index of the array. The conditional statement will go down to AND include 0, the `i--` means subtract 1 from `i` every time it goes around, so eventually `i` will be 0.

Each question has an explanation, written by the contributor

Why are the other's incorrect?

(A) This loop would crash at the end.

`i = 0`, this is fine, it is the first value of the index and is correct.

BUT

The conditional inside the while loop is: `i <= array.length`, which means it can be less than OR equal to `array.length`, which is 15. The last index is 14, thus when it attempted to find index 15 of the array, it would crash with an out of bounds error.

(B) This suffers the exact same problem as A, but has been rendered in 'for' loop format.

(D) The loop shown for D would not crash, but nor would it completely cycle through all values of this array.

`int i = array.length - 1` as discussed above will result in 14 which is correct for the last index of our array,

However,

The conditional: `i > 0` will not ever allow this loop to check index 0. It will stop after cycling through 1.

(E) This loop again will not crash, but will not cycle completely through all values of this array.

`int i = 1` means that 0 will not be evaluated.

the conditional inside the while loop will stop the cycle correctly at 14 to prevent the crash.

★★★★★★★★

Sneaky. Very good, although it is not how one normally thinks of looping through an array, it is a common pitfall and very well highlighted. Well explained as well.

★★★★

Good testing of understanding of loops. Awesome.

★★

while I think the question is quite confusing, this is a great question.(and very great explanation by the way).

★★

Nice question. A way of looping I hadn't considered

★★

Thinking about the various different increments and normally involve an ascending value of `i`. Brilliant:)

★

Good questions to understand loops and array... Good explanations as well... thank you...

Students who answer the question can provide feedback to the author, and rate other students' feedback

Research results

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Closing remarks

- Data collected for several large courses since 2007
- High voluntary use for study revision
- Participation is strongly correlated with improved exam performance
- Biggest gains in top and bottom ability students; suggests **multiple learning effects**
- Many high-quality questions
- Broad range of course topics covered

P. Denny, A. Luxton-Reilly, and J. Hamer. Student use of the PeerWise system. In *ITiCSE'08: Proc. 13th SIGCSE Conference on Innovation and Technology in Computer Science Education*, pages 73–77, New York, 2008. ACM.

P. Denny, J. Hamer, A. Luxton-Reilly and H. Purchase. PeerWise: Students Sharing their Multiple Choice Questions. *ICER'08: 4th International Computing Education Research Workshop*, pages 51–58, Sydney, Australia, 2008.

P. Denny, A. Luxton-Reilly, J. Hamer and H. Purchase. Coverage of Course Topics in a Student Generated MCQ Repository. In *ITiCSE'09: Proc. 14th SIGCSE Conference on Innovation and Technology in Computer Science Education*, (to appear), New York, 2009. ACM.

What do students think?

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Closing remarks

- “The biggest learning experience for me was setting up my multi-choice question. . .

. . . in the end it was a lot of help because i was just about able to answer any question that was on the same topic as my question”

Survey results

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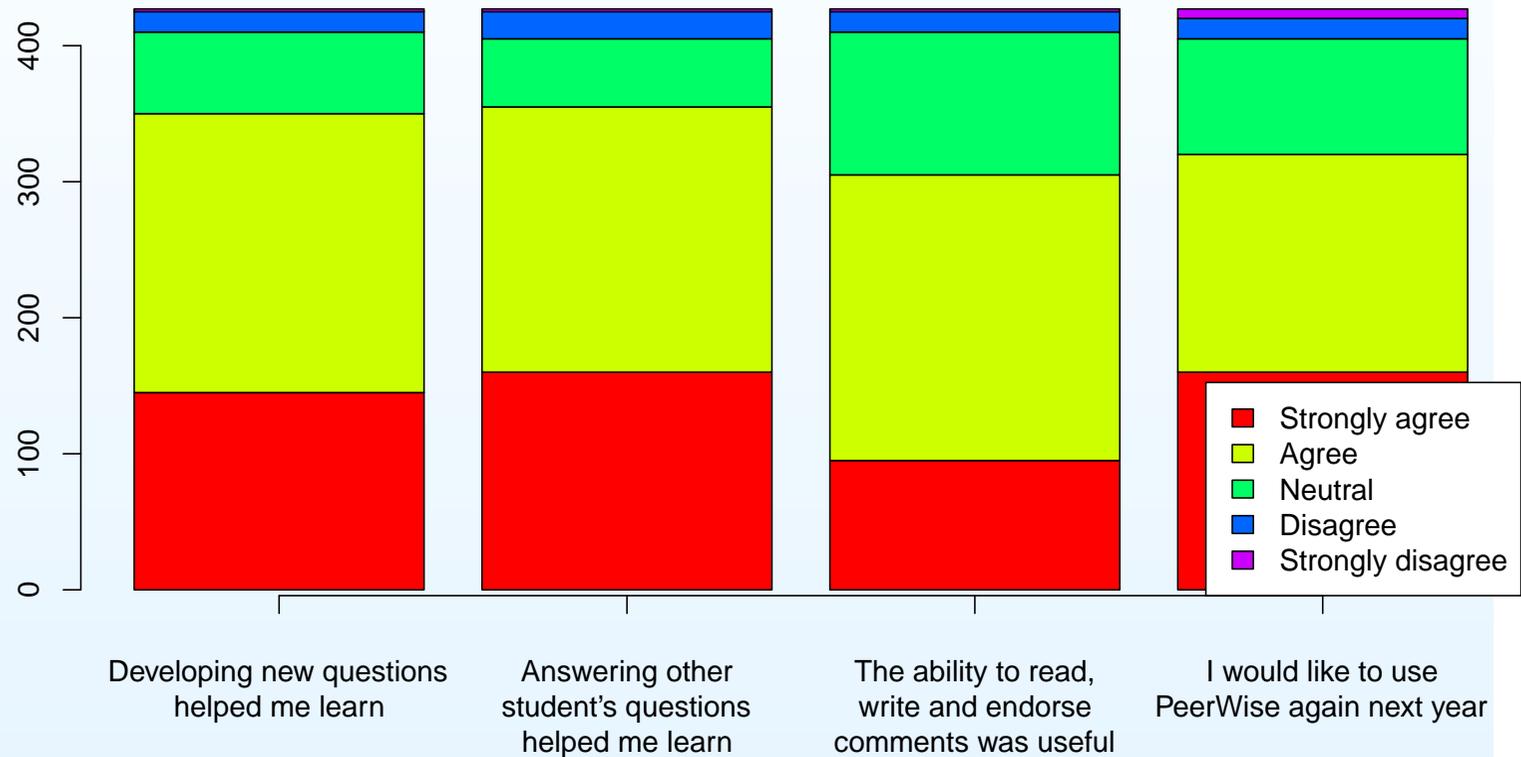
- Student generated MCQ bank
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- What do students think?

● **Survey results**

- Students use the system voluntarily
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Students use the system voluntarily

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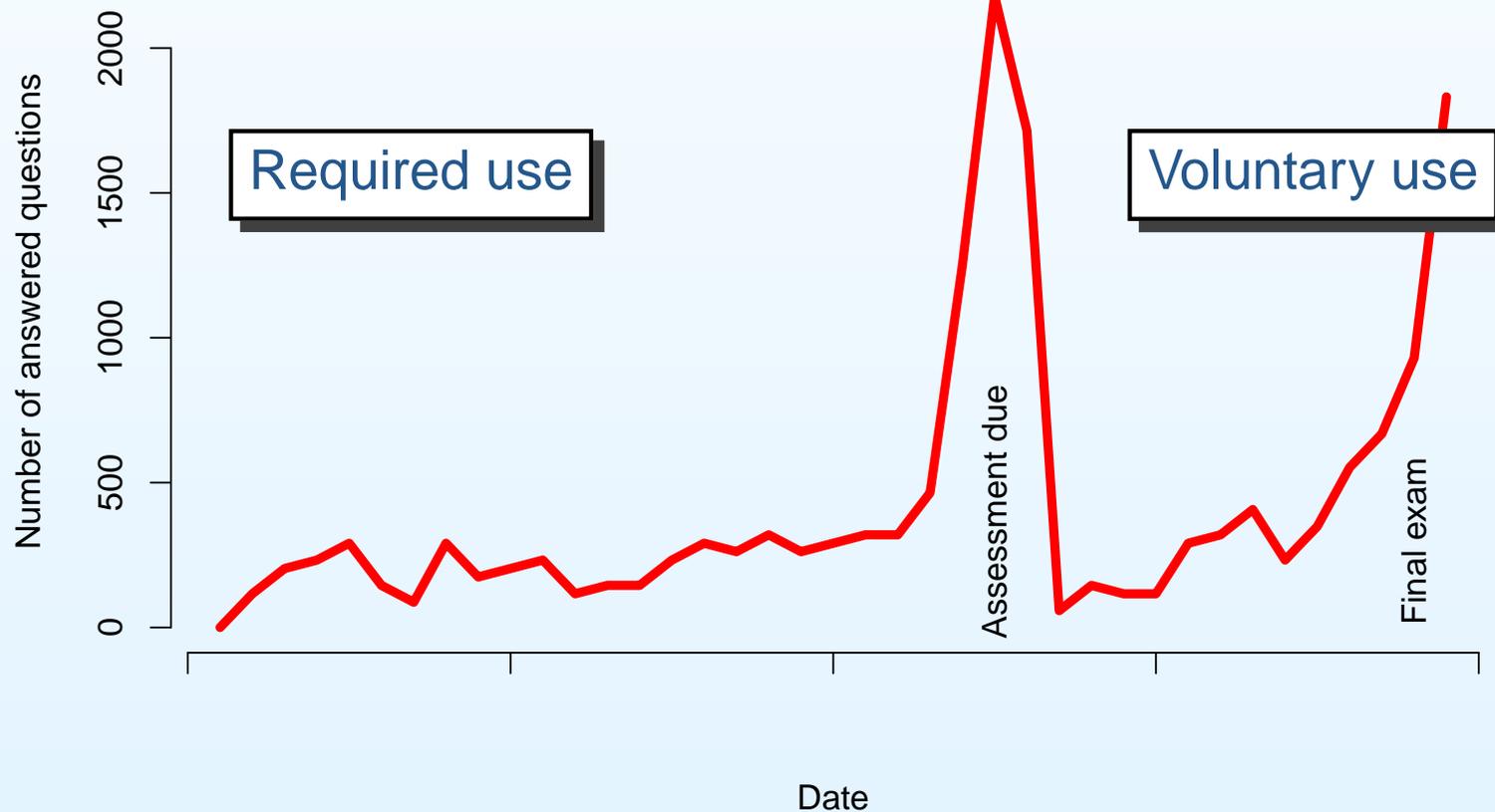
[PeerWise \(Paul Denny\)](#)

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Questions answered per day



Students rate questions accurately

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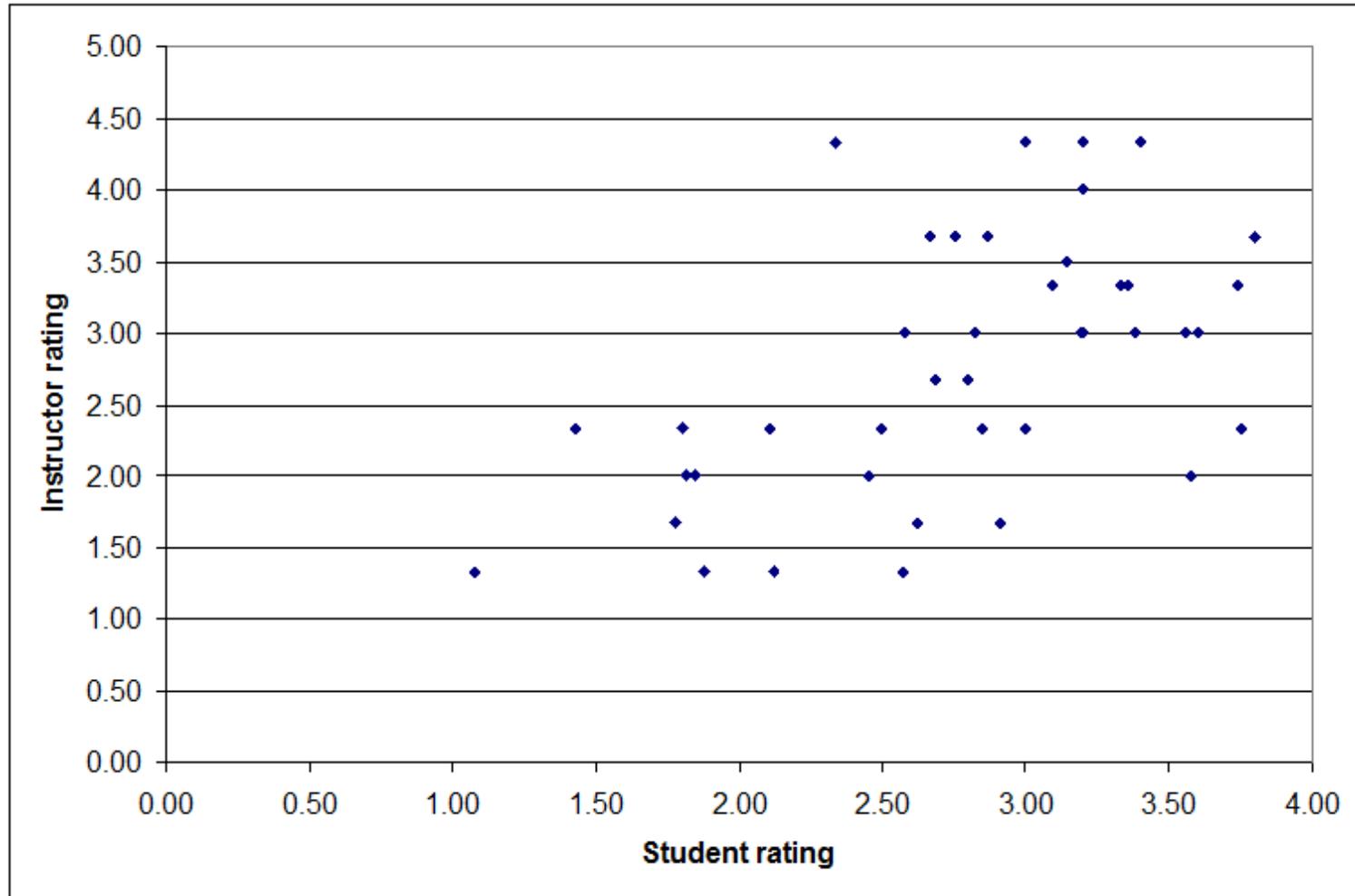
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Ratings are used effectively

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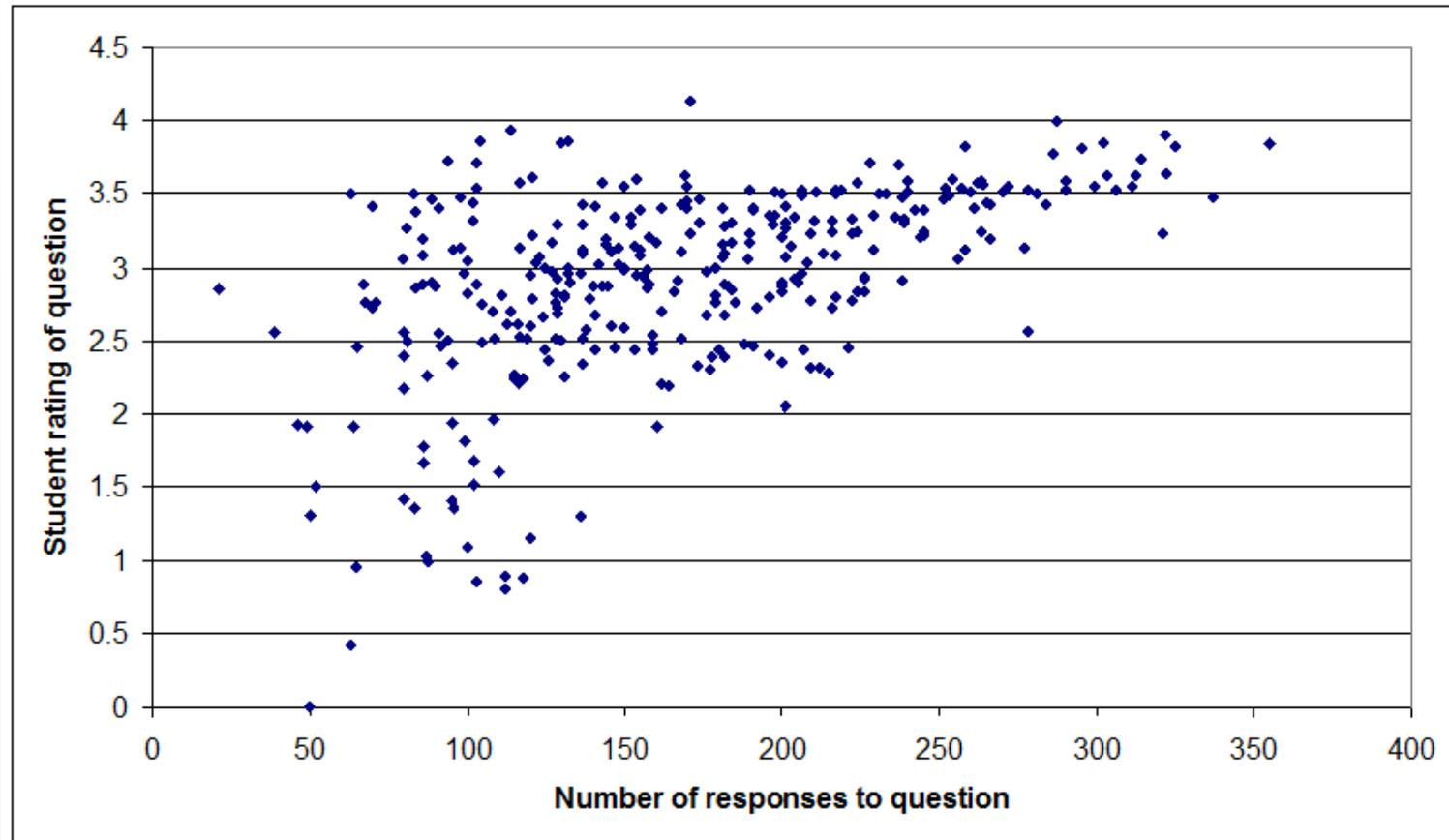
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Broad coverage of course topics

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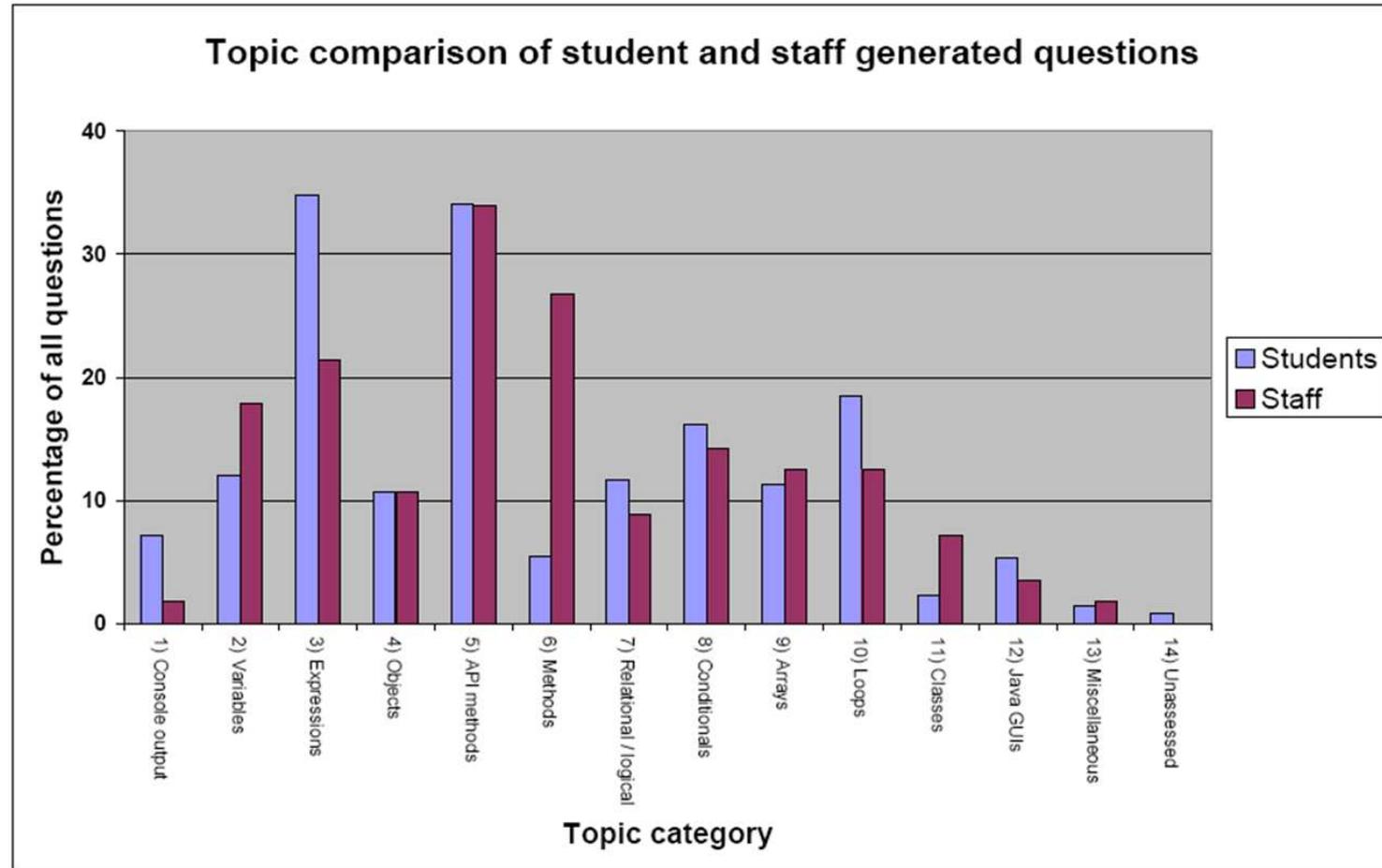
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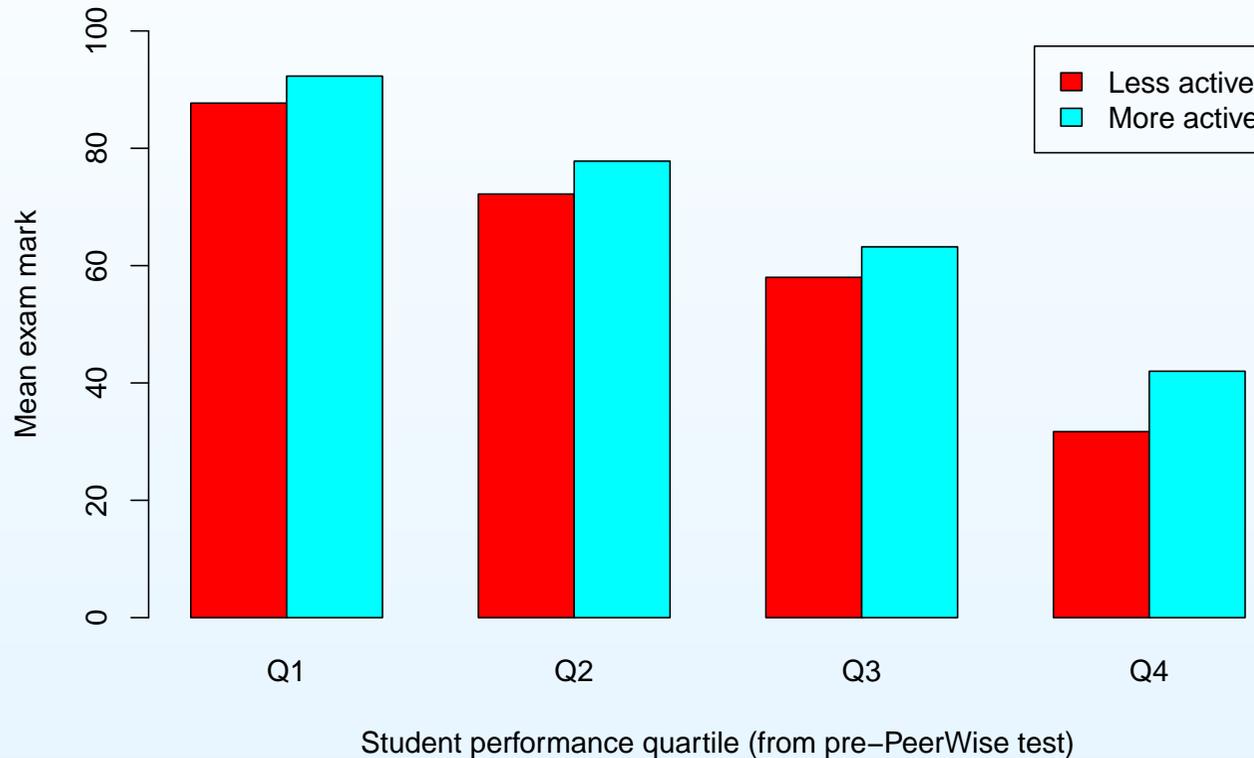
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PeerWise (Paul Denny)

Looking ahead

- Digital document annotation
- Penmarked reviewing system
- Evaluation
- Marking time
- Number of annotations
- Student satisfaction with the process
- Student opinion of the aid to learning
- Student overall preference

Closing remarks

Looking ahead

Digital document annotation (Beryl Plimmer/Paul Mason)

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● **Digital document annotation**

● Penmarked reviewing system

● Evaluation

● Marking time

● Number of annotations

● Student satisfaction with the process

● Student opinion of the aid to learning

● Student overall preference

Closing remarks

- Provides rich work spaces and better engagement with the material
- Technical challenges
 - Layered interface
 - Synchronizing the layers (many “standard” components do not expose extension points)
 - Reflow when document changes
 - Recognition and document analysis

Penmarked reviewing system

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- Digital document annotation
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Closing remarks

```
AssemblyInfo.vb | Class1.vb | frmCalendar.vb | xmlFile.vb |
Imports System.IO
Imports System.Runtime.Serialization.Formatters.Soap
' if you get a syntax error on the line above you need to add a reference to your
' project - in the solution explorer expand references, right click, add reference
' find the reference system.runtime.serialization.formatters.soap and double click and ok
' to add

Public Class xmlFile
    'save and read file
    'the file is saved into the program's bin directory
    'double clicking on the file FirstName from explorer will open it in explorer

    Public Function LoadFile(ByVal fileFirstName As String, ByRef o As Object) As Object
        Dim datFile As FileStream
        Try
            datFile = New FileStream(fileFirstName, FileMode.Open)
            Dim fileformatter As SoapFormatter = New SoapFormatter()
            LoadFile = CType(fileformatter.Deserialize(datFile), x) 'add object type here
        Catch lerr As Exception
            MessageBox.Show(lerr.Message)
            LoadFile = New x 'add object type here
        Finally
            Try
                datFile.Close()
            Catch
            End Try
    End Function
End Class
```

good defensive programming



Evaluation

Introduction

Peer Assessment

PeerWise (Paul Denny)

Looking ahead

- Digital document annotation
- Penmarked reviewing system

- **Evaluation**

- Marking time
- Number of annotations
- Student satisfaction with the process
- Student opinion of the aid to learning
- Student overall preference

Closing remarks

- One large programming class \approx 180 students
- Six markers
- Three assignments, increasing in size and complexity
- Three treatments
 - Paper
 - “database”
 - Penmarked
- Balanced treatment
 - Each student had one assignment marked by each process
 - Each marker used each process
 - Rotated so student \times marker different for each assignment

Marking time

[Introduction](#)

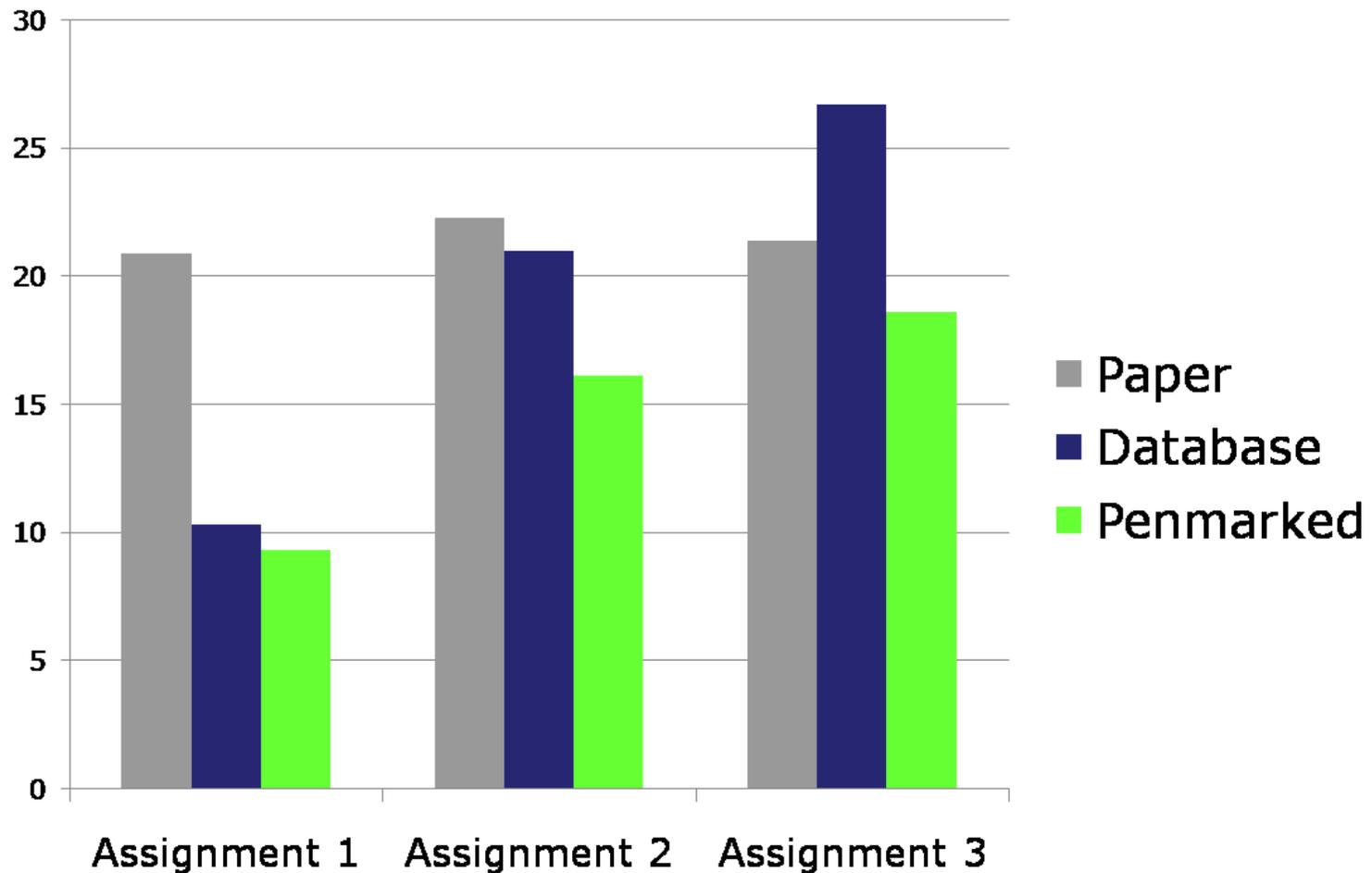
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Number of annotations

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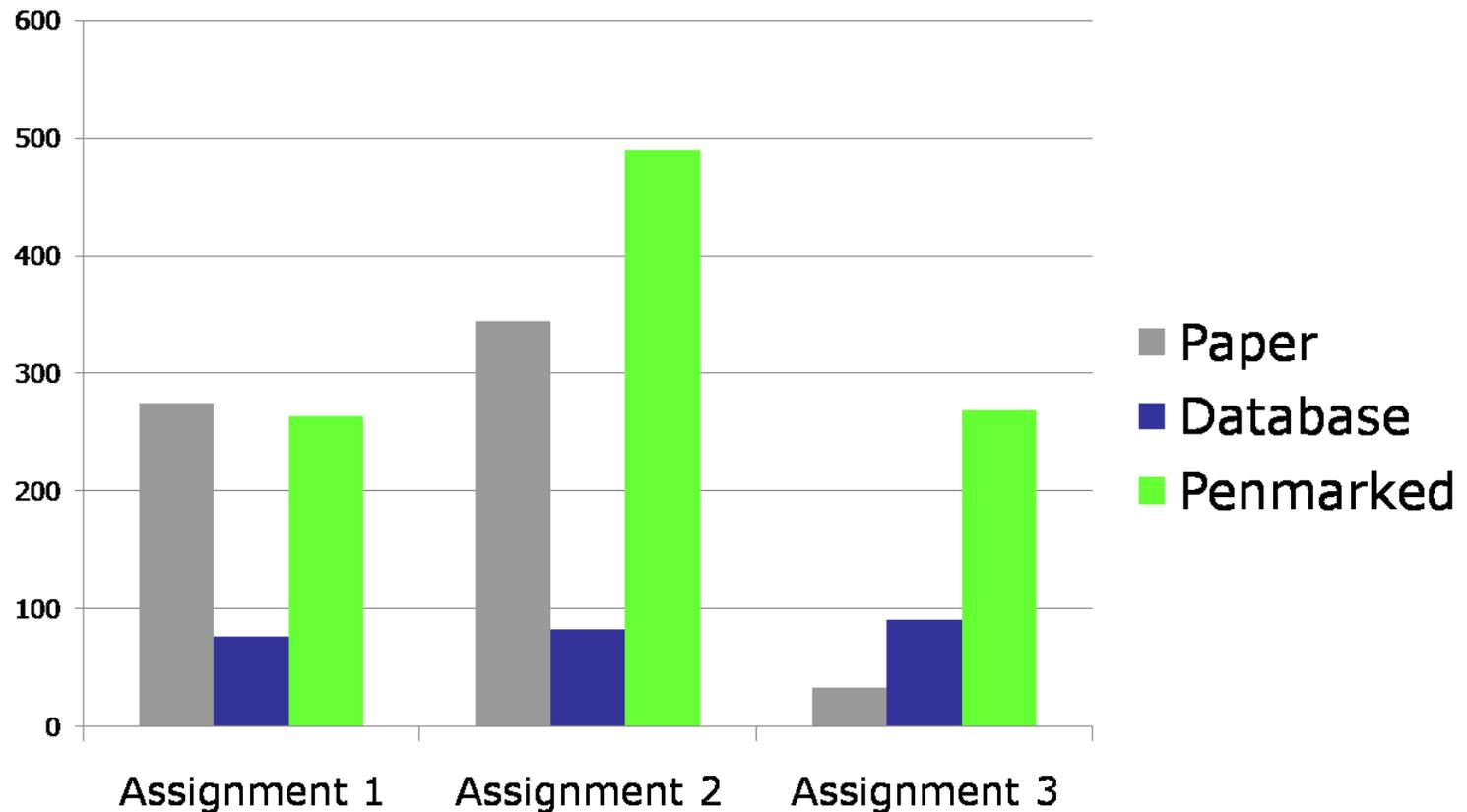
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Student satisfaction with the process

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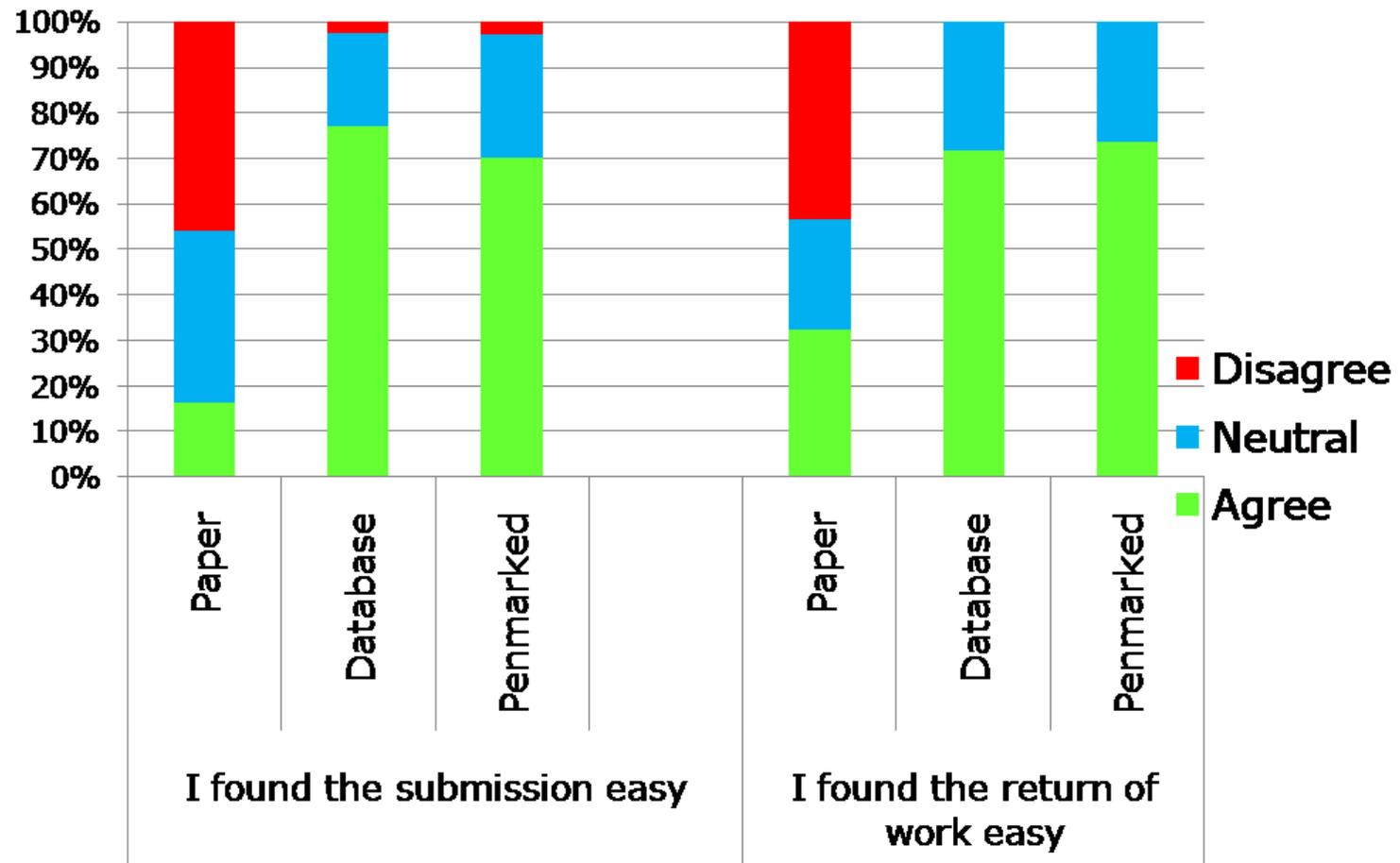
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Closing remarks



Student opinion of the aid to learning

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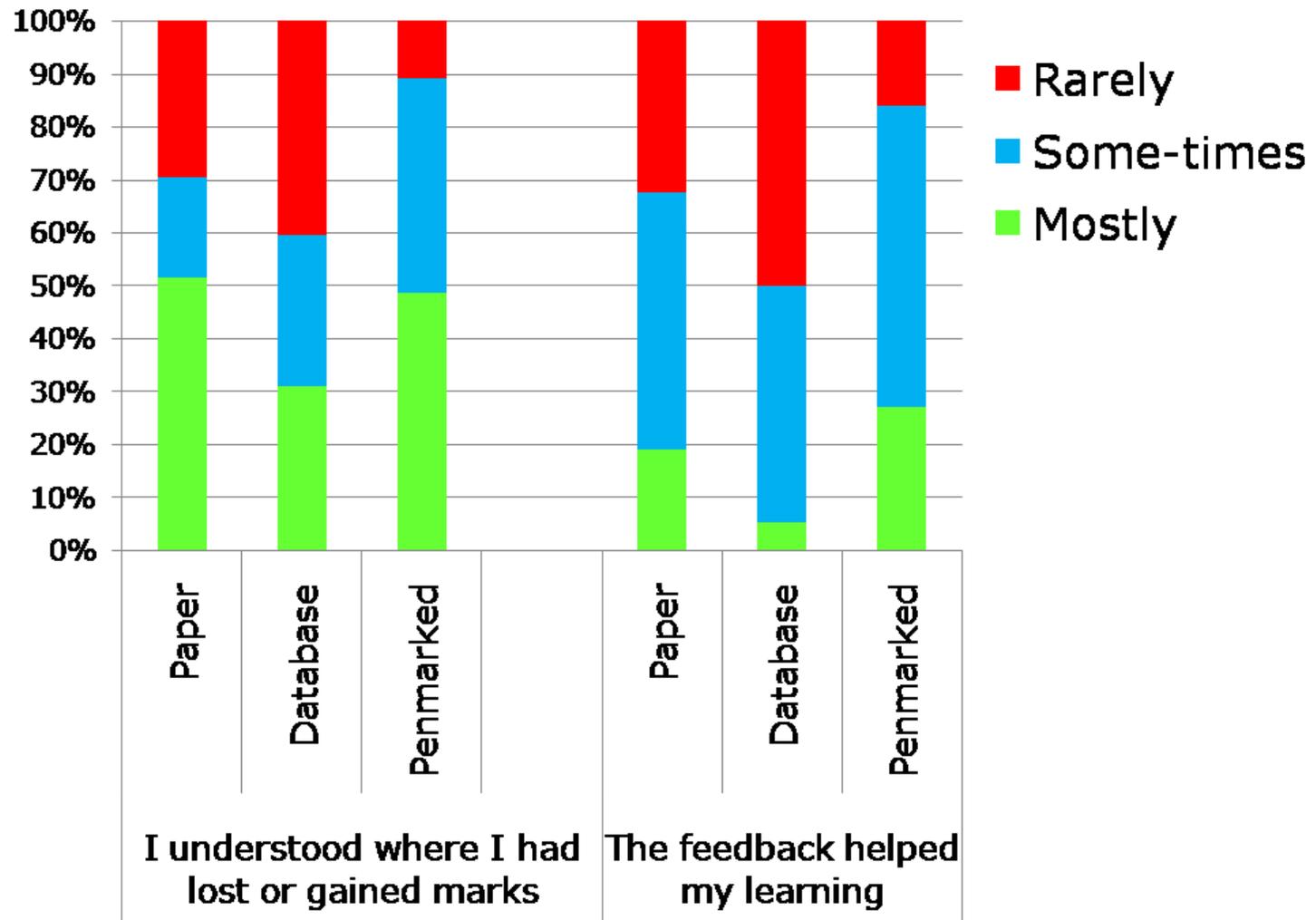
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Student overall preference

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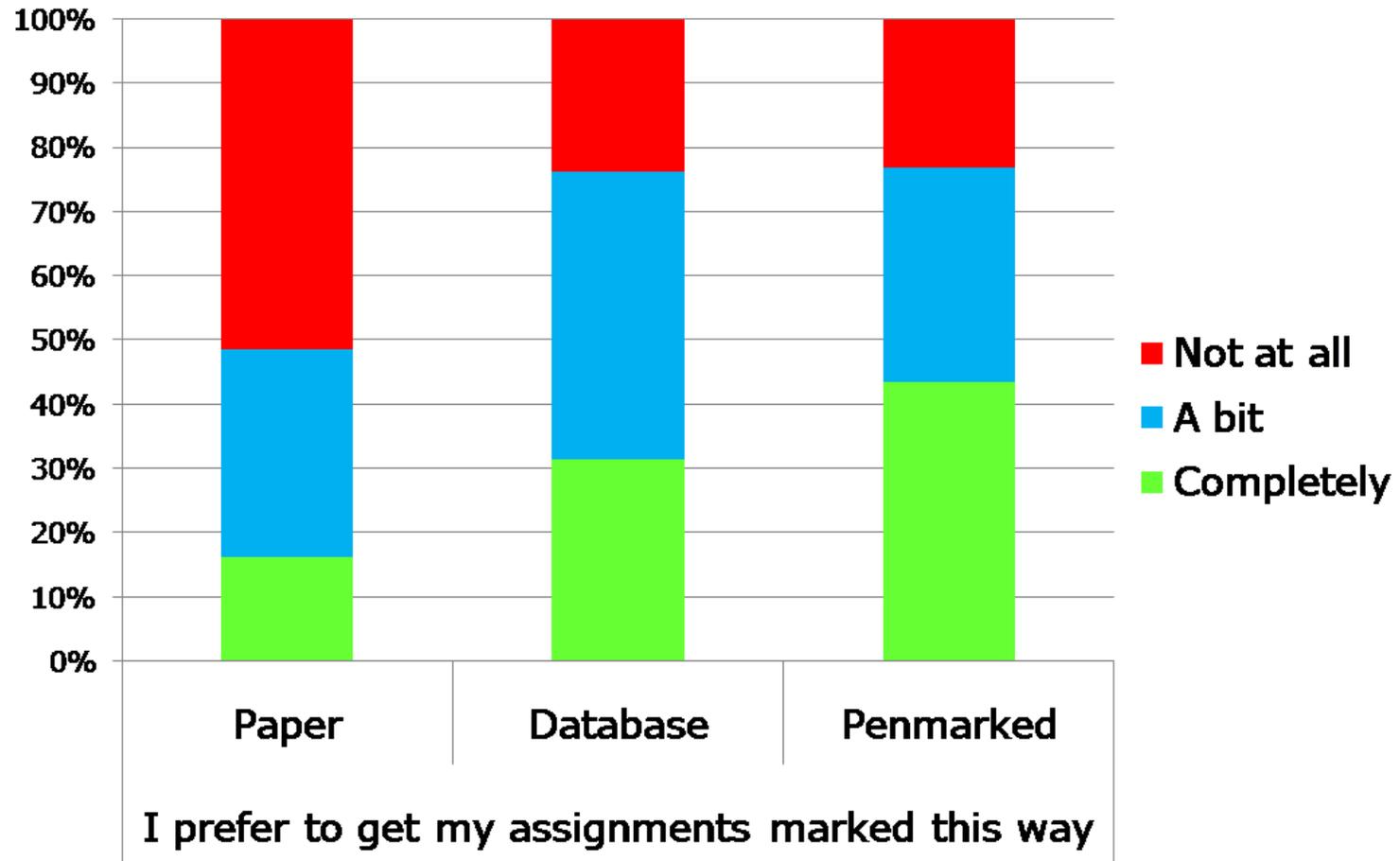
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Closing remarks



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PeerWise (Paul Denny)

Looking ahead

Closing remarks

- How do these tools contribute to learning?
- Digital ink
- Links

Closing remarks

How do these tools contribute to learning?

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Looking ahead

Closing remarks

● **How do these tools contribute to learning?**

● Digital ink

● Links

Aropä

- Thinking about assessment criteria: what makes a good answer?
- How do you respond to conflicting feedback? Builds confidence to challenge others' opinions
- Opportunities to learn from both exemplary and poor quality work

PeerWise

- To come up with a good question and explanation, you really need to understand the material
- Good detractors identify misconceptions

Digital ink

Introduction

Peer Assessment

PeerWise (Paul Denny)

Looking ahead

Closing remarks

- How do these tools contribute to learning?

- **Digital ink**

- Links

- Digital ink is an emerging technology; will soon become pervasive
- Allows rich, natural feedback
- Easier to generate, so markers provide more feedback
- Feedback is superimposed on the original document, so it's easier for students to see where it applies

Links

Introduction

Peer Assessment

PeerWise (Paul Denny)

Looking ahead

Closing remarks

- How do these tools contribute to learning?
- Digital ink
- **Links**

Aropä

<https://aropa.ec.auckland.ac.nz>
<http://www.cs.auckland.ac.nz/~j-hamer>

PeerWise

<http://peerwise.auckland.ac.nz>

Digital ink

<http://www.cs.auckland.ac.nz/~beryl>