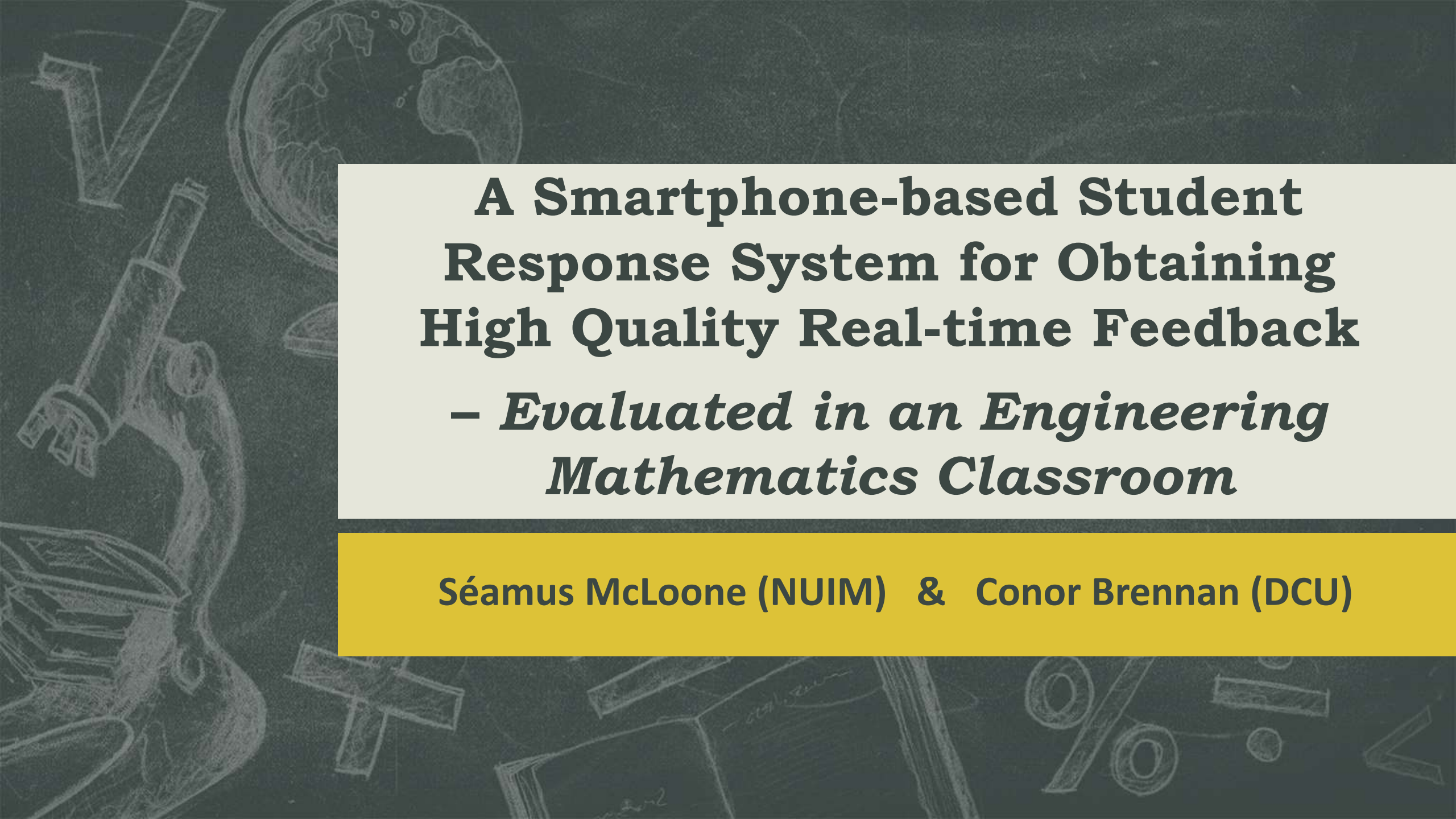

A Smartphone-based Student Response System for Obtaining High Quality Real-time Feedback – *Evaluated in an Engineering Mathematics Classroom*

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Summary of Presentation

- Acknowledgements
- Classroom response systems – limitations
- Smartphone-based response system
- Classroom evaluation & feedback

  – Engineering Mathematics
- Questions
- *Demo available on request !*

Acknowledgements

We would like to express our sincere gratitude to:

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the 3U N-STEP Strand 1 Scheme

for providing the funds for this project.

Thank you also to the students that helped evaluate our system.

Classroom Response Systems (CRS)

- CRS exist in various different guises …

  Audience Response Systems

  Student Response Systems

  Electronic Voting Machines

  Clickers, etc…

CRS – Basic Idea

- Typically consist of a transmitter (for the students), a receiver (for the lecturer) and appropriate software to collate and present the data.
- Students can reply to a question posed by the lecturer.
- This information is collected and can be neatly presented to both the lecturer and the students (using suitable graphs, etc.)
- Lecturer can determine how well students are following the lecture.

CRS – Benefits

- Research shows that the use of such systems can …
  - increase student interaction
  - improve student learning
  - increase student preparation for classes
  - increase student attendance
  - increase student satisfaction
  - create an enjoyable learning atmosphere
  - be used for student assessment
  - obtain anonymous student feedback

CRS – Limitation

Sketch a function …

Write an equation …

Draw a Venn Diagram …

Sketch a circuit …

Draw a Karnaugh Map …

HOW ?

Current response systems only allow for multiple choice selections.

CRS –Limitation

- The lack of a freeform input is a major drawback for STEM subjects.
- It is important that our students can input mathematical equations, sketch circuits, apply graphical techniques, etc.
- These are of particular relevance to Engineering and Science disciplines where such information is core to the student learning.
- Here, the approach to solving a problem is often as important, if not more so, than the actual final answer itself.

A Smartphone-based CRS

- Three main components required:

  - a student app with sketch capabilities

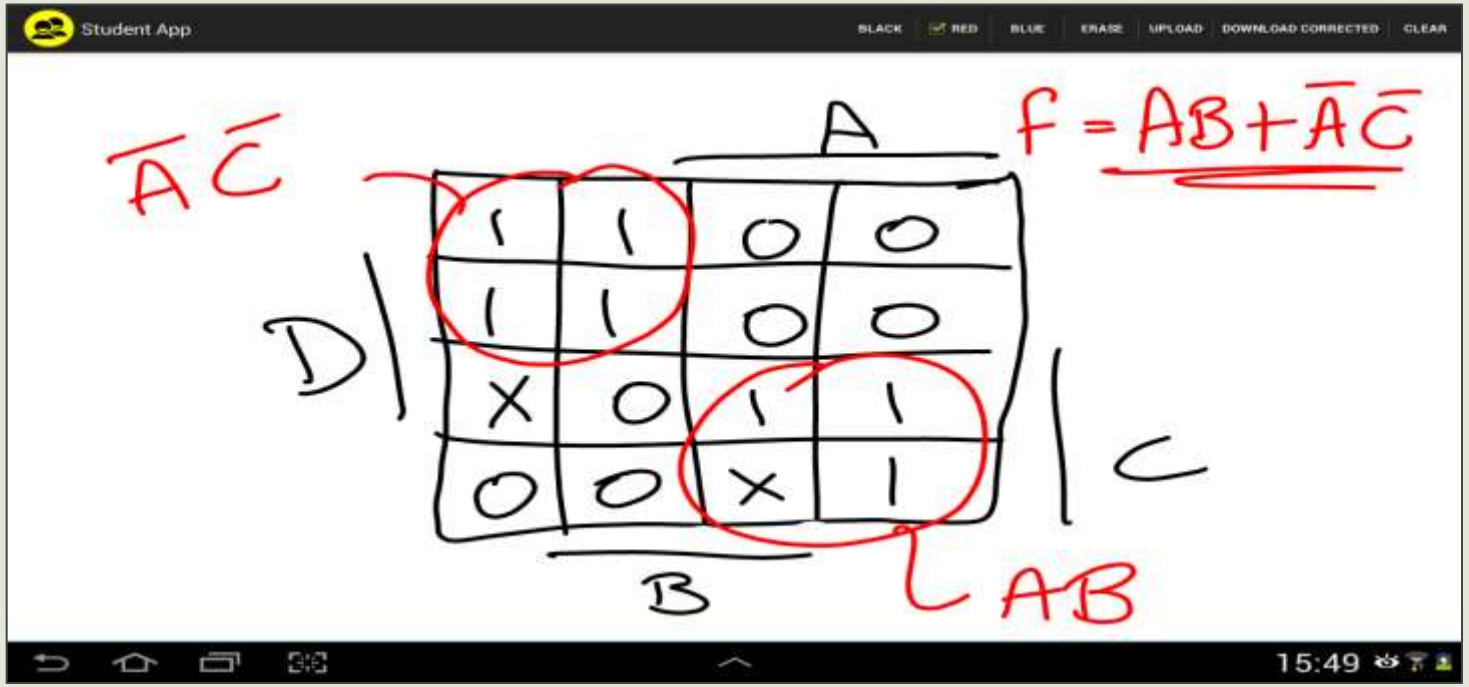
  - a lecturer app for viewing and editing of multiple images

  - a central server to communciate between applications

Currently developed for devices using the Android operating system

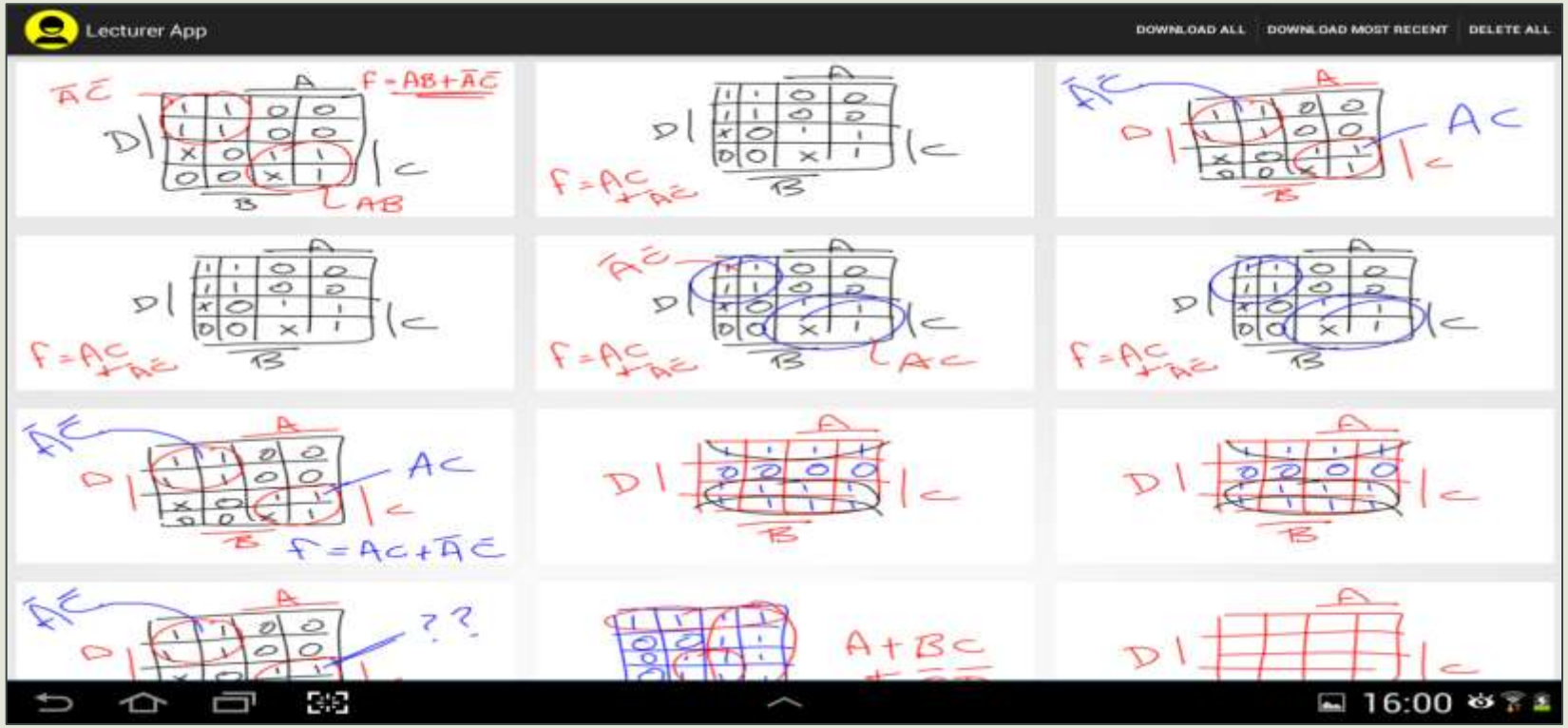
The Student App

- Simple with basic sketch capabilities
- Limited options – easy to use, yet functional



The Lecturer App

- Good viewing capabilities - essential
- Editing capabilities also available



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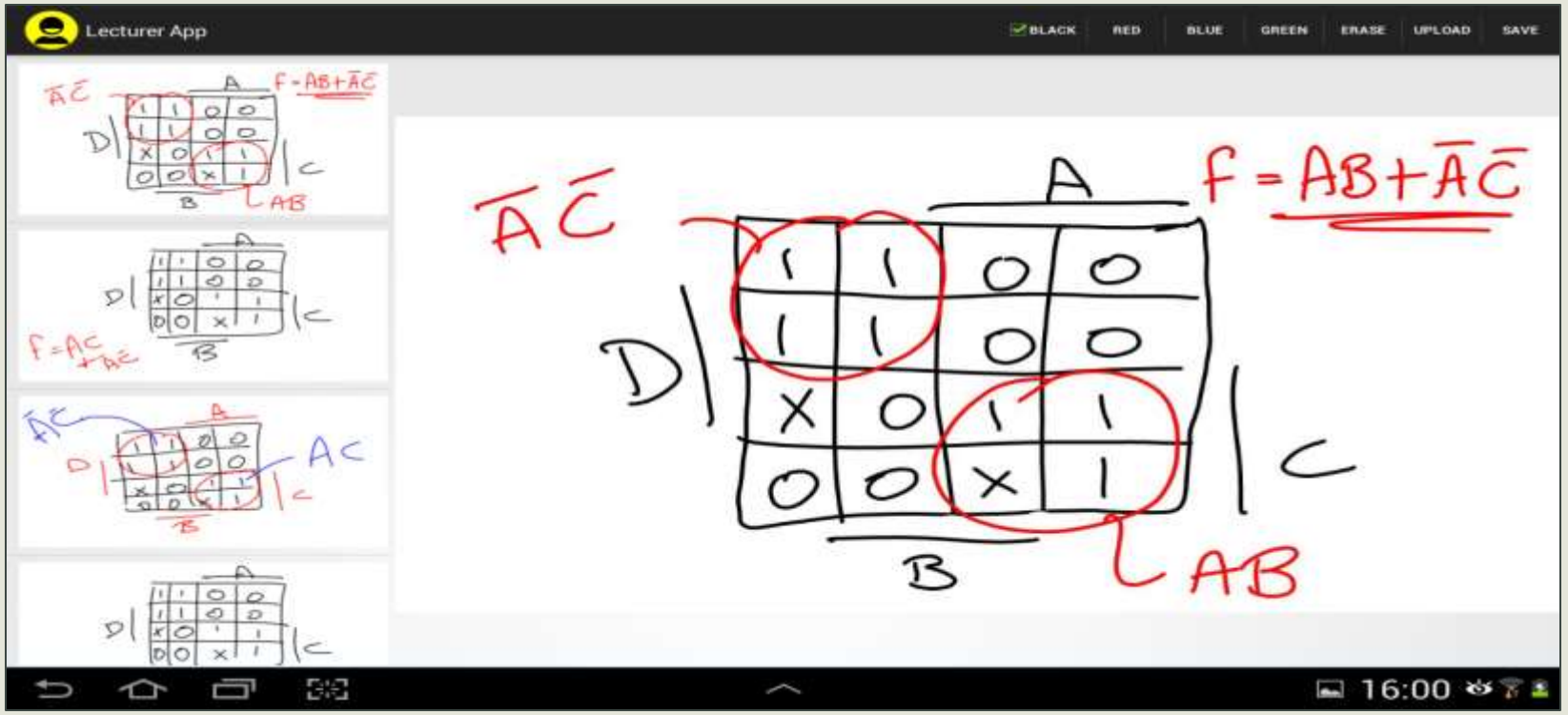

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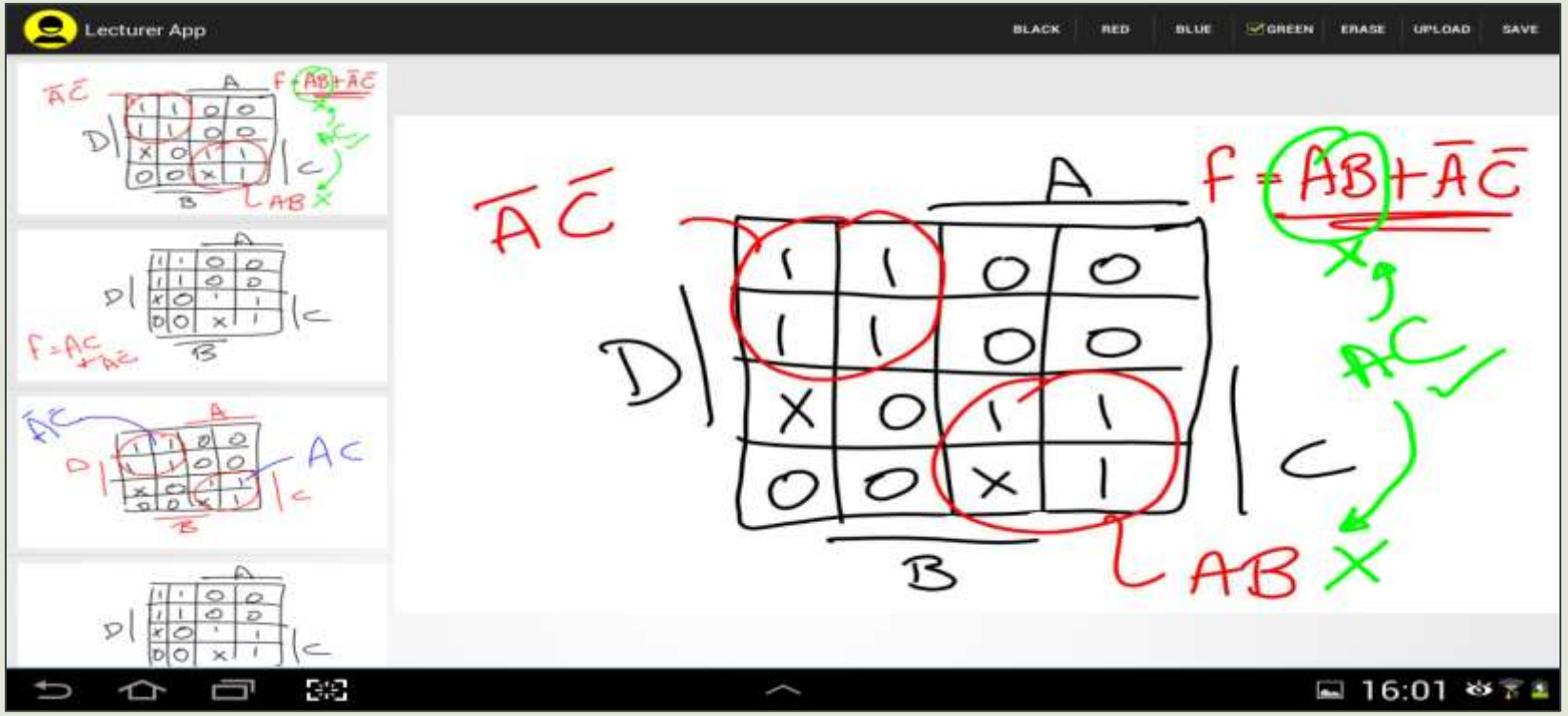
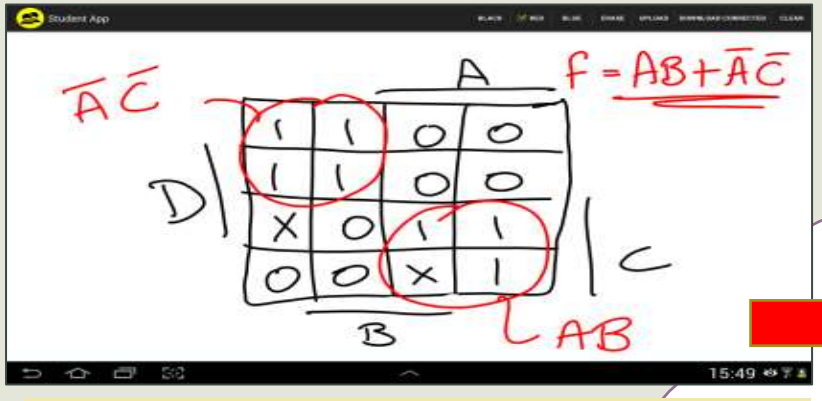


The Central Server

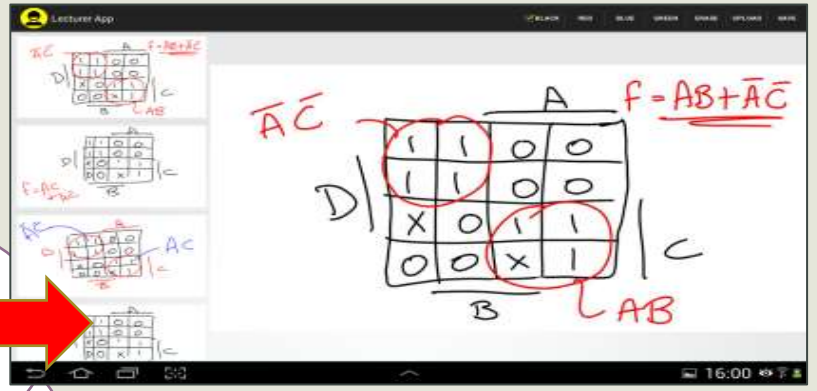
- Hidden component of system from a user's point of view.
- Co-ordinates the exchange of responses between the student and the lecturer applications.
- Here, we use a cloud based service - the Google App Engine.
- Allows us to work with non-Android systems in the future.
- Suitable student and lecturer applications could be written for other devices, such as the iPad and the iPhone, which would seamlessly integrate with current CRS.

Smartphone-based CRS - Overview

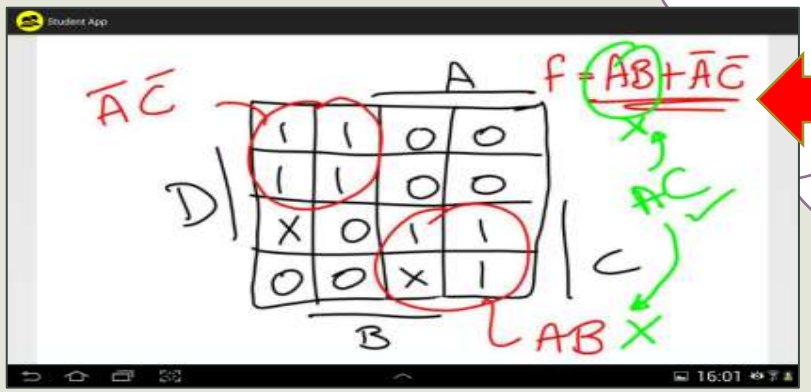


Student Submits

Cloud Service

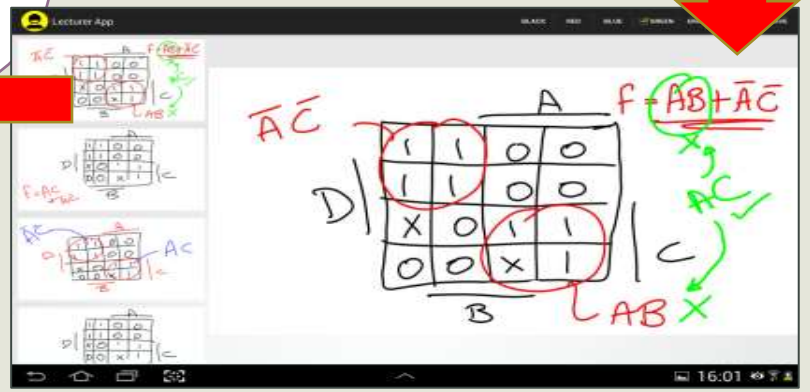


Lecturer Receives



Student Receives

Student Tablet



Lecturer Corrects

Lecturer Tablet

Classroom Evaluation

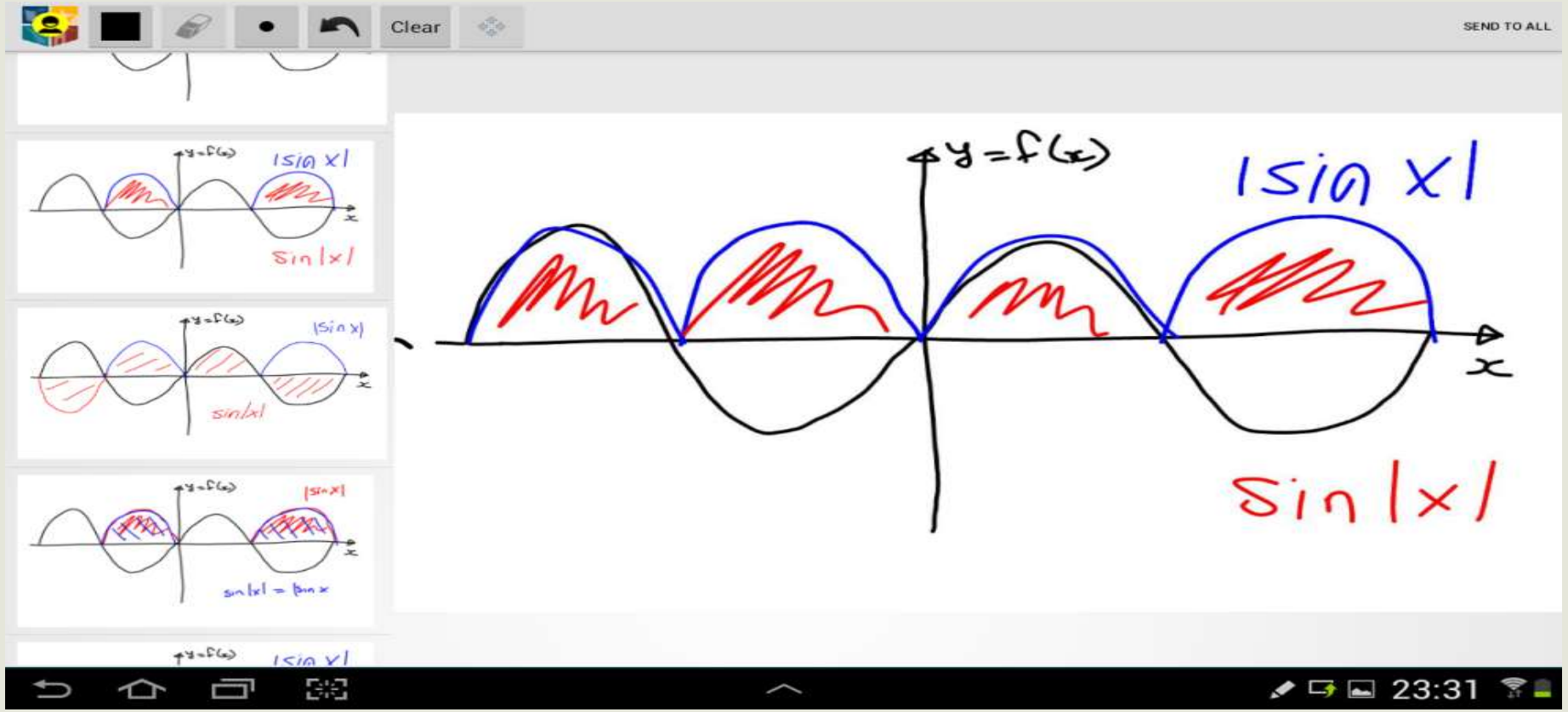
- Evaluated by first year Engineering Mathematics students at DCU.
- Tested in lectures – lecturer posed several questions and students responded with suitable sketches using their smart phones.
- A sample of one such question …

Given the function $f(x) = \sin x$, sketch …

$g(x) = |\sin x|$ and $h(x) = \sin |x|$.

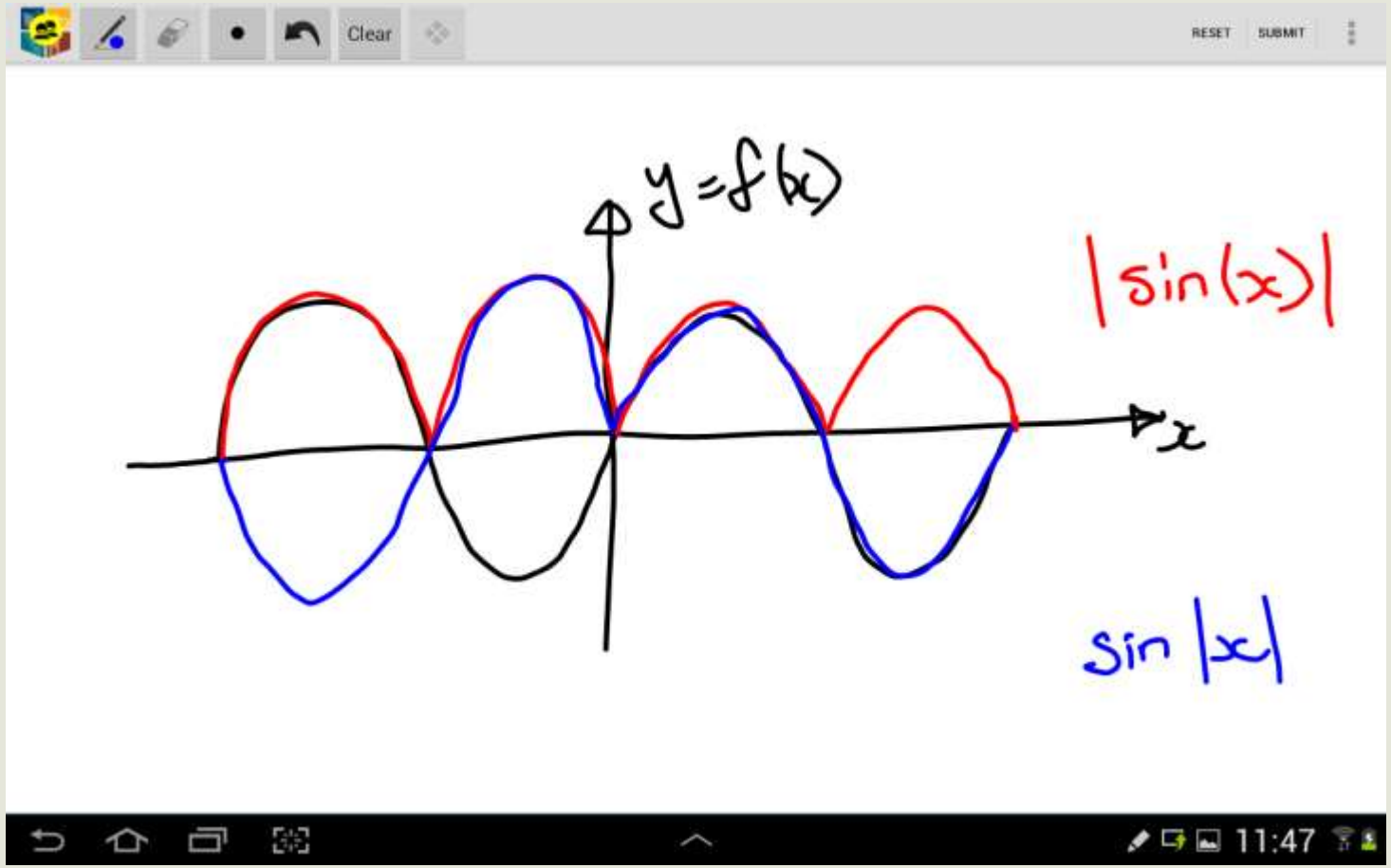
Classroom Evaluation

- Most common incorrect answer …



Classroom Evaluation

- The correct answer …



Classroom Evaluation

- 40% to 50% of the attending class of students had access to Android based smart phones or tablets.
- Students who did not have a suitable device were teamed up with someone who did and so the exercises were all group-based.
- In total, 46 survey forms were completed and returned to the lecturer at the end of the evaluation sessions.

Evaluation – Results

Statement	Average rating (1–5)	Std. dev.
I found the app easy to use	**4.15**	**0.70**
I felt the app was quick as responsive	**3.15**	**1.23**
The app performed as expected	**3.33**	**1.03**
The app provided a good way to interact in class	**4.35**	**0.79**
The app provided a good way to give feedback/responses	**4.22**	**0.92**
The flexibility of providing a sketch is really useful	**4.22**	**0.99**
The use of the response system makes my learning more enjoyable	**4.50**	**0.55**
I was motivated to respond to the lecturer’s questions using this system	**4.30**	**0.76**
I would like to use this response system again	**4.30**	**0.76**

Evaluation – Comments

- Students felt that the flexibility of providing a sketch as an input option was really useful.
- They felt that the system provided a good means of interacting in class.
- They were motivated to respond to the lecturer's questions and wanted to use the system in future classes.
- Application was not quick and responsive and did not work as they expected. This issue was largely due to some inherent bugs in the current system, which is still very much a work in progress.

Evaluation – Students

- Noted that the SRS was a positive way of "*interacting between student and lecturer*."
- They "*liked the freedom of drawing*" their "*own answer*" and found the graphical input useful and felt that it allowed the lecturer to see if they really understood the material.
- As expected, most students appreciated the "*fact that all submissions were anonymous*" allowing them to provide responses without the fear of being identified and it also meant that they were "*less worried about the answer being wrong*."

Evaluation – Lecturer

- Noted that the sessions were keenly enjoyed by the class who responded very well to the different class-room dynamic.
- It certainly served its purpose of breaking up an otherwise passive 2-hour slot.
- Would like to use it more widely in his future lecturing.
- Felt it was important to choose questions that are simple and clearly assess a small number of principles.

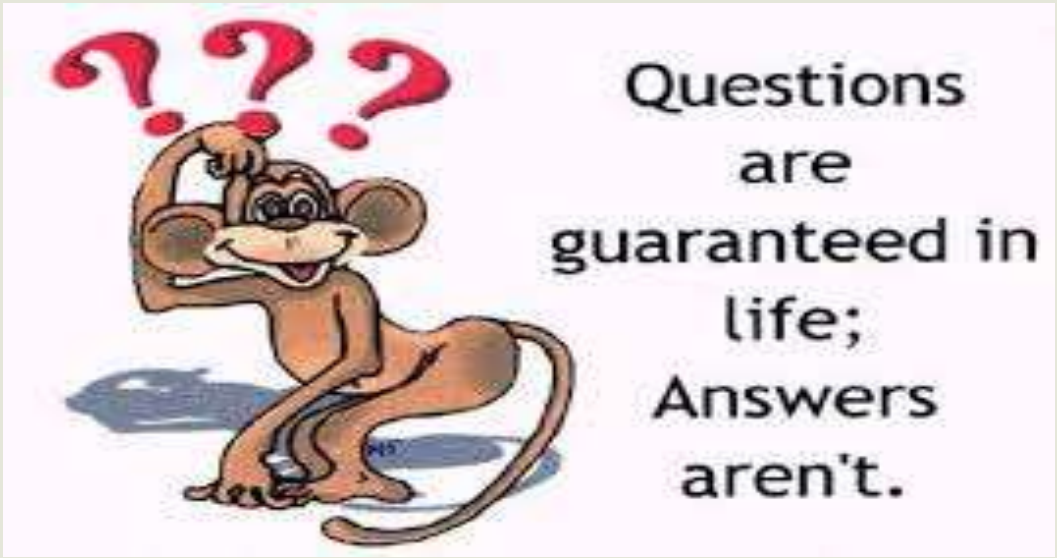
Evaluation – Lecturer

- Highlights the importance of a visual understanding of mathematics .
- Consider the case of sketching a function - the simple drawing scheme means that students are forced away from their traditional approach of computing several input-output pairs and interpolating between them.
- Instead they must perform a simple free-hand sketch based on their intuitive understanding of the function's behaviour.
- It is this understanding that constitutes real mathematical knowledge.
- While students are resistant to this approach, allowing them to practice in a relaxed classroom atmosphere is one step towards developing this skill.

Conclusions

- Here, we have presented a classroom response system that has freeform input capabilities, allowing for students to respond to questions with graphical sketches, mathematical equations, circuit diagrams, etc.
- The system was evaluated by a first year Engineering Maths class in DCU.
- They found the system easy to use, liked the flexibility that a sketch input offers and found it a useful, motivating and enjoyable response system to use in class.

QUESTIONS



DEMO (on request, after talk) ...