

## Background

In 2011 we introduced Classroom Response Systems (Clickers) in two consecutive physics lectures [1]. Based on the positive feedback, both from the lecturer and from the students, two additional lectures were supplemented with voting facilities in 2011. We now opted for flashcards in order to reduce the technical and financial overhead.

In early 2012 Eric Mazur presented peer instruction at ETH Zurich. In consequence further lecturers became interested in voting systems.

Due to the easy handling of flashcards, three more lecturers were able to supplement their courses with voting facilities.

In autumn 2012, ETH Zurich has launched a smartphone app (eduApp) that includes voting functionality [2]. After first tests this app turns out to be promising for replacing the clickers and flashcards systems.

## Setting

- We use voting systems for:
  - peer instruction (concept questions with peer discussion)
  - formative assessment (concept questions without peer discussion)
  - interactive lecture demos (demo predictions) [3]
- We supplement traditional lectures with 1 – 6 questions/week.
- We mainly use voting systems for large lectures (200-500 students)
- Student participation is voluntary and anonymous.

## Flashcards vs. Clickers

From a pedagogical viewpoint both systems turn out to be equivalent [4]. We did not observe any differences on the engagement in peer discussions. However, low participation turns out to be a major limitation of clickers. Furthermore, we have noticed that student participation with clickers decreases significantly in the course of the semester. The use of flashcards, on the contrary, results in continuous high participation rates.

### Pros

Flashcards	Clickers
easy to handle	robust data transmission
no usage restrictions	statistics feedback
high student participation	ready for peer instruction

### Cons

Flashcards	Clickers
no statistics	additional device
limited functionality	software compatibility
no data recording	low participation rates



Fig. 4: Clickers



Fig. 5: Peer discussion



Fig. 1: Flashcards

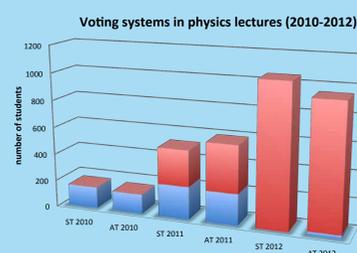


Fig. 2: Number of students using clickers and flashcards

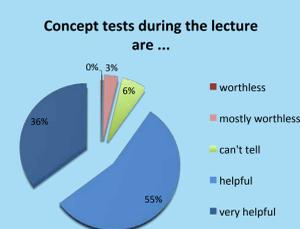


Fig. 3: Student rating of voting questions (N=353; 3 lectures; AT 2012)

## Conclusions

Clickers are extremely useful for small courses (20-30 students), where anonymity is essential.

With flashcards, lecturers have a very easy-to-use instrument for trying out peer instruction. In large classes the lecturer instantly gets a perfect overview of the response distribution and students don't feel uncomfortable to apparently lose their anonymity.

Smartphone apps such as eduApp [2] or LearningCatalytics [5] combine the ease of flashcards with the data management of clickers. The future might belong to them.

### References:

- [1] Bruff, D. (2009). Teaching with classroom response systems: Creating active learning environments. San Francisco: Jossey-Bass.
- [2] ETH Zurich eduApp [[http://www.eduapp.ethz.ch/ueber\\_en.html](http://www.eduapp.ethz.ch/ueber_en.html)]
- [3] Crouch, C.H., Fagen, A.P., Callan, J.P. & Mazur, E. (2004) Classroom Demonstrations: Learning Tools or Entertainment? American Journal of Physics 72, 835-838.
- [4] Lasry, N. (2008). Clickers or flashcards: Is there really a difference? The Physics Teacher 46(4), 242-244.
- [5] LearningCatalytics [<https://learningcatalytics.com>]

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Fig. 6: ETH eduApp