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THE UNIVERSITY  
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AUSTRALIA

# How to make students active participants in your lectures

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# Lectures

- **Learning drops dramatically after 15min listening passively**
  - **Students retain 70% of first 10min**
  - **Students retain 20% of the last 10min**
- **Students' attention is not on the lecture 40% of the time**
- **Long term retention is 8% more information than non-lectured controls**

Meyers and Jones (1993) Promoting Active Learning

Bligh, D. (1998). What's the use of lectures. Exeter: Intellect.

(Frederick, 1986; Foley & Smilansky, 1980; Stuart & Rutherford, 1978).

Meyers and Jones 1993 summarises McKeachie 1986, Verner and Dickson 1967, Rickard et al 1988

# Lectures

- **Advantages**
  - **Transmission of information to large groups**
  - **Explanation of difficult concepts**
  - **Research enriched information**
- **Disadvantages**
  - **No opportunity for active application by students**
  - **No opportunity for development of thinking skills**
  - **Unable to modify student attitudes**

Bligh (1998) What's the use of lectures.

(Frederick, 1987; McKeachie, 1994; Newble and Cannon, 1994).

1. (a) I. Halloun and D. Hestenes, "The initial knowledge state of college physics students," *Am. J. Phys.*

**53**, 1043-1055 (1985); corrections to the Mechanics Diagnostic test are given in ref. 14; (b) "Common

sense concepts about motion," *ibid.* **53**, 1056-1065 (1985).

And another 8 ref's from the intro to Hake 1998

## **Possible solution**

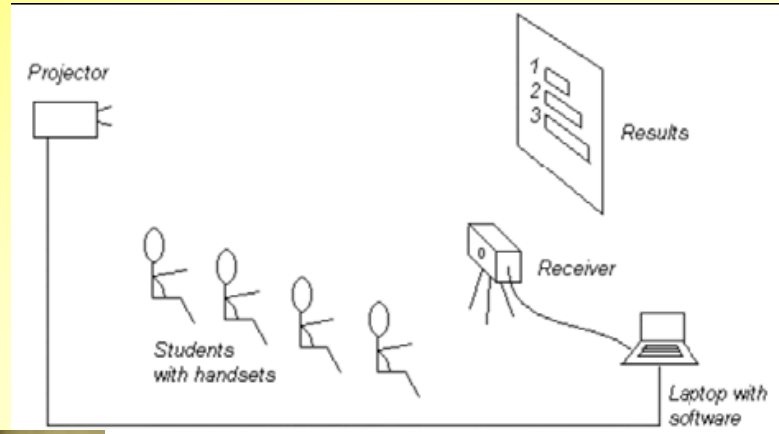
- **Active learning with feedback significantly increased scores on standardised tests**
- **Ask questions of students during lecture**
  - **Opportunity to stop and actively use new information**
  - **Opportunity to reinforce key concepts**
  - **Provides feedback to lecturer and students**
- **... if the students actually answer the questions**

Hake 1998

Incorporation of EVS technology in otherwise traditional lectures for collecting and displaying student responses to questions has been shown to increase active learning, depth of learning and student interest (Elliott, 2003, Stuart et al., 2004) and these learning benefits are demonstrated across diverse disciplines (Draper & Brown, 2004).

(Butler, 1992; Feden, 1994; Kraft, 1985; Murray, 1991).

# Electronic voting system (EVS)



Wit 2003

## **Advantages of EVS**

- **Everyone remains anonymous**
- **Whole class can respond quickly**
- **Results are displayed immediately**
- **Results are easy to interpret and use**

## Effects of EVS on student experience

- **Students report that using EVS**
  - **improves their understanding of difficult concepts**
  - **allows them to be actively involved in learning**
  - **gives them more time to think and reflect in class**
  - **receiving immediate feedback motivates them**
  - **74% thought useful to very useful**

Draper & Brown 2004, Boyle & Nicol 2003, Wit 2003, Cue 1998

Stuart et al 2004: useful but time consuming, given the choice of response as verbal, hands up, EVS most would work out the answer for handset, then hands up and verbal alone 0%

In the interviews and survey, all students reported that the teaching methods used in the wired classroom helped them improve their understanding of difficult concepts when compared with conventional lecture classes. The reasons they gave included more active involvement in learning, more time to think and reflect in class (i.e. when given a concept test), the motivational effects of receiving immediate feedback (the histogram display) and the feeling that the teacher was adapting instruction in response to their learning needs. These findings are reported in detail elsewhere (Boyle & Nicol, 2003).

Wit 2003: 74% thought useful to very useful, 87% more advantages than disadvantages

**Freeman and Blayney** Compared hands up with EVS and found that significantly more students strongly agreed that EVS increased their level of interaction, increased their understanding and increased their ability to gauge to gauge understanding

# Methods

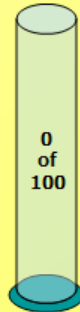
- **2<sup>nd</sup> year Human Physiology**
- **8 cardiovascular lectures**
- **140 students are enrolled,**
  - ~85 responses for most questions
- **Students collected a keypad at the beginning of each lecture**
  - Completely anonymous
- **Questions on lecture material**
  - Application of new concepts
  - Recall of information from previous lectures
- **Pre- and post-EVS evaluation questions**
  - Student experience
  - Likert scale responses

84 students participated in Post-EVS eval, with 34-43 results missing from each Q

89 students participated in Post-EVS eval, with 3-9 results missing from each Q

## This increase in cardiac output and total peripheral resistance results in...

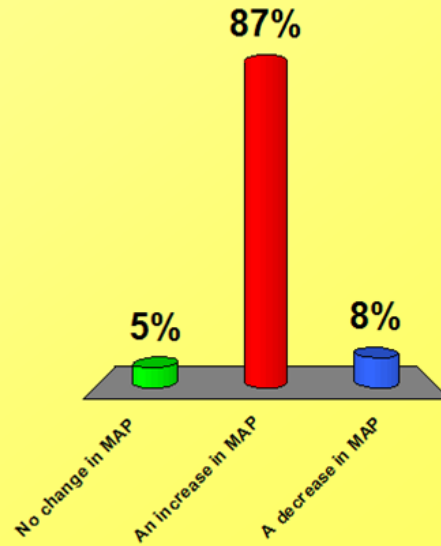
1. No change in blood pressure
2. An increase in blood pressure
3. A decrease in blood pressure



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

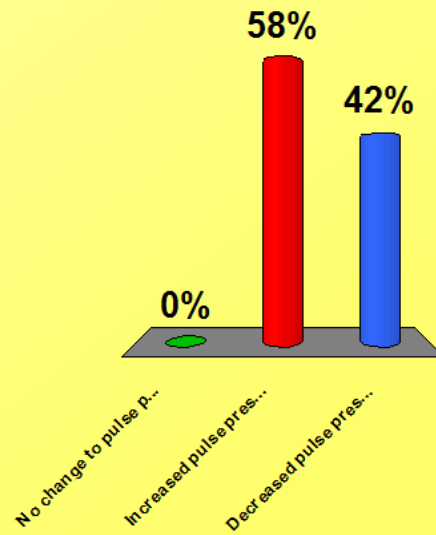
**This increase in cardiac output and total peripheral resistance results in**

- 1. No change in blood pressure**
- 2. An increase in blood pressure**
- 3. A decrease in blood pressure**



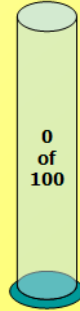
## Reduced arterial compliance in the elderly results in...

1. No change to pulse pressure
2. Increased pulse pressure
3. Decreased pulse pressure



I think this process will increase my understanding of lecture material.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

I think this process will increase my understanding of lecture material.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

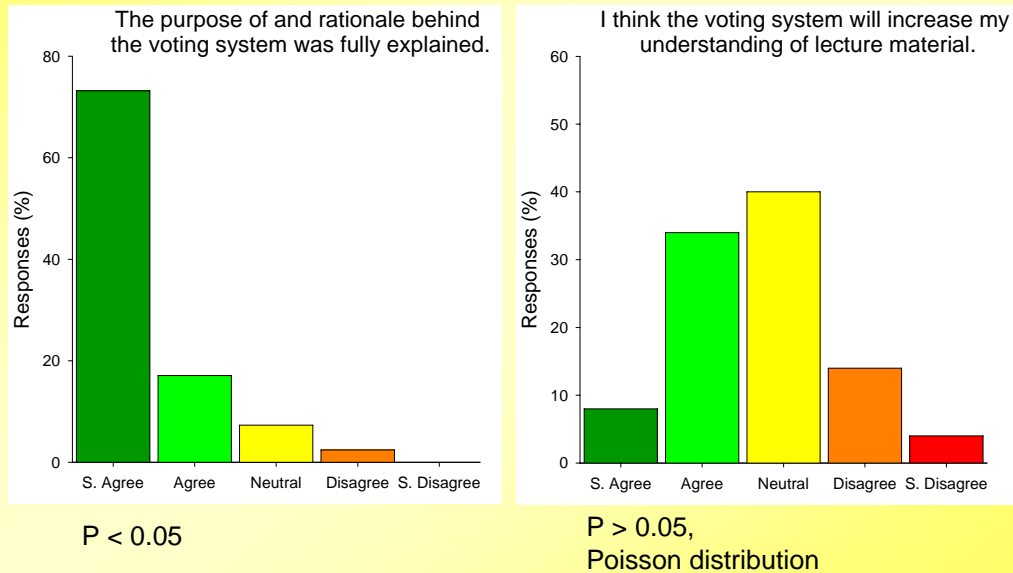
**Results were  
kept confidential**

## **Statistical analysis**

- **Likert responses**
  - Numerical, categorical (ordinal) data
- **Comparisons between pre-EVS and post-EVS responses for matched questions**
  - Mann-Witney U-test ( $P < 0.05$ )
- **Single response questions compared to uniform and Poisson distributions**
  - Kolmogorov-Smirnov test ( $P < 0.05$ )

47+/-2 pre-EVS responses,  
84+/-1 post-EVS responses

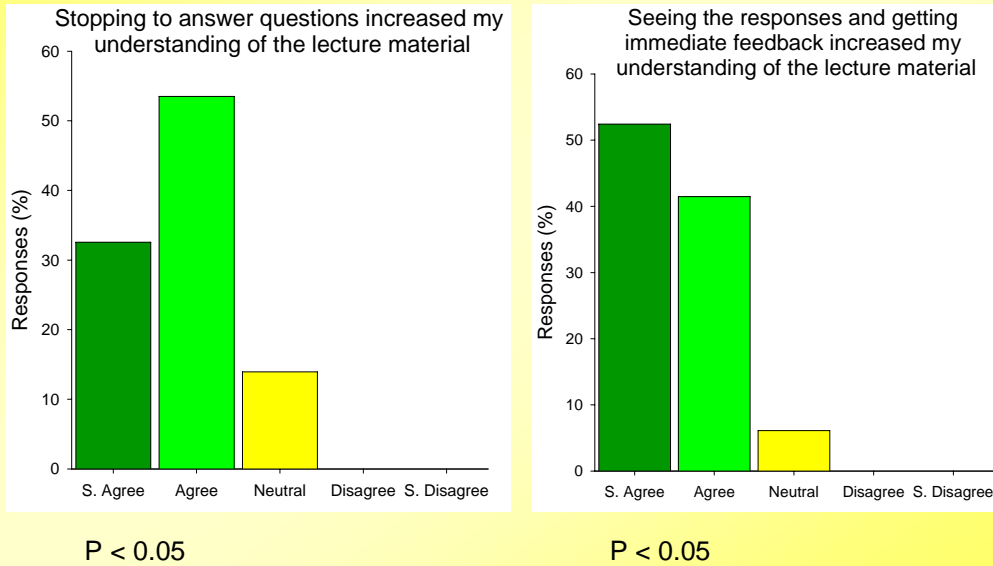
# Student expectations of EVS



After the rationale for including the EVS technology in the lecture series was explained, the students agreed that the theoretical rationale and purpose were explained clearly ( $1.4 \pm 0.1$ , figure 1) but overall, the students were not convinced that the inclusion of the EVS based question would actually increase their understanding of the lecture material ( $2.7 \pm 0.1$ , figure 2). Interestingly, after eight lectures with the EVS incorporated, there was a significant shift in student opinion with responses indicating that both stopping to ask questions ( $1.8 \pm 0.1$ , figure 3) and seeing the responses and getting immediate feedback ( $1.5 \pm 0.1$ , figure 4) increased their understanding of the lecture material.

90.3 % s – agree was well explained

## Effect of EVS on understanding



**Significant change in attitude after “using” the system!!!**

**20) Stopping to answer questions increased my understanding of the lecture material – 83.2% agree to strongly agree**

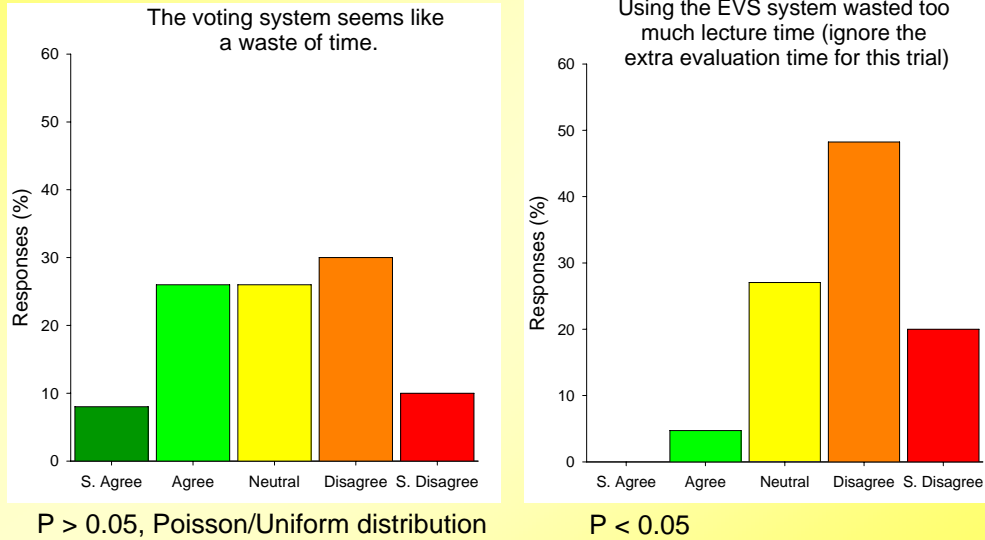
**21) Seeing the responses and getting immediate feedback increased my understanding of the lecture material – 86.5% agree to strongly agree**

## Results summary

<b>Strongly agreed or agreed</b>	<b>Using EVS ...</b>
<b>66%</b>	<b>allowed me to recall new knowledge</b>
<b>68%</b>	<b>allowed me to use new knowledge</b>
<b>75%</b>	<b>allowed me to integrate concepts</b>
<b>84%</b>	<b>made me more active in lectures</b>
<b>85%</b>	<b>helped me to maintain interest in the lecture</b>

25) I looked forward to using the voting system in lectures

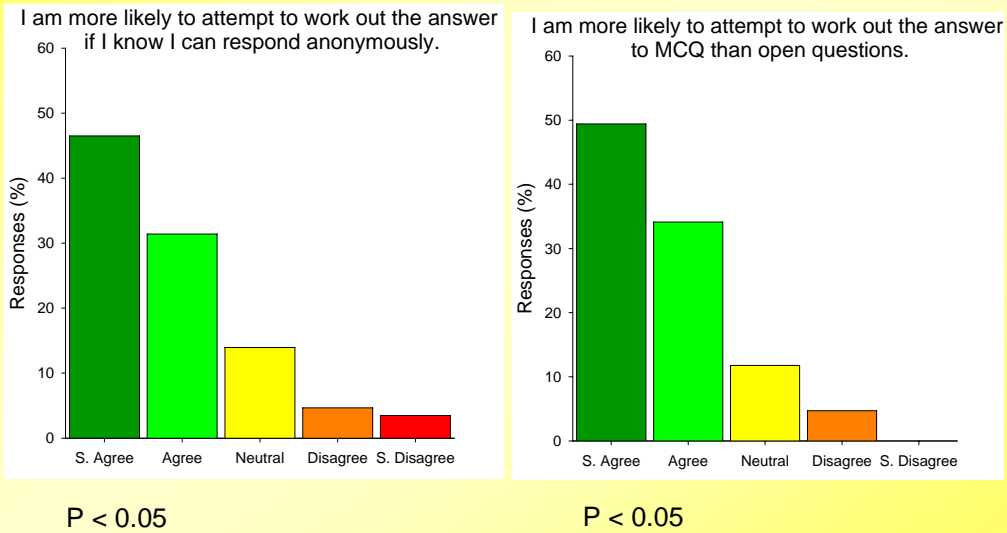
## Was the EVS an effective use of lecture time?



Significant change in opinion after using the system

Previous investigations have found that the technical problems associated with setting up EVS technology wastes valuable lecture time, as indicated in evaluations by lecturers and students (Draper & Brown, 2004, Stuart et al., 2004). In the first two lectures there were significant delays due to setting up the EVS equipment and the system was nearly disregarded on those occasions. Fortunately the system always came through and after the 3rd lecture, the equipment was running within the ten minute gaps between lectures. This improvement in implementation of the system is likely to be reflected in the change in student response, in the pre-EVS evaluation students expected the system would waste a lot of lecture time ( $3.1 \pm 0.2$  figure 9) and after the eight lectures they were satisfied that the system had not wasted too much lecture time ( $3.8 \pm 0.1$ , figure 10).

# Specific advantages of EVS



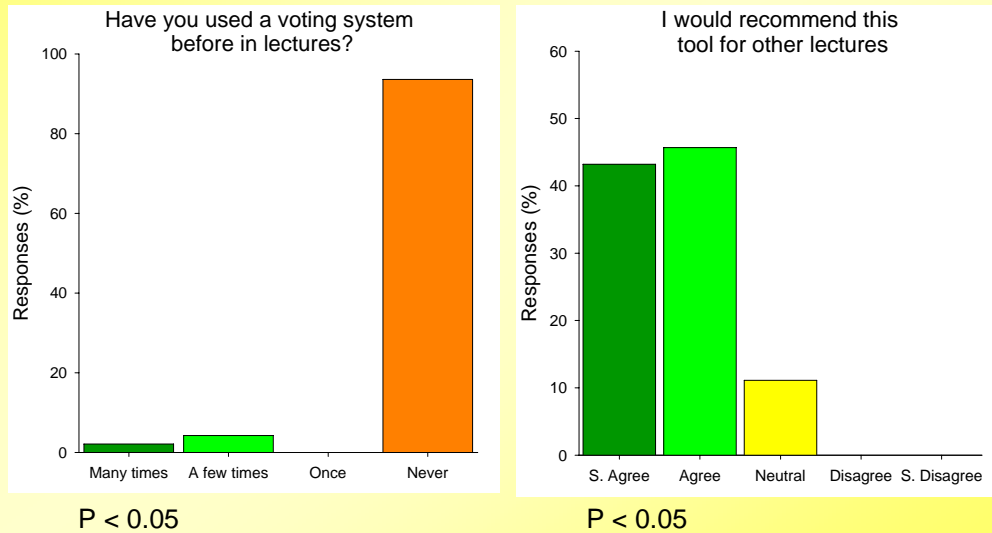
**18) I am more likely to attempt to work out the answer to MCQ than open questions. – 79.8% agree to strongly agree**

**19) I am more likely to attempt to work out the answer if I know I can respond anonymously. – 75.2% agree to strongly agree**

17.) Why didn't you respond during the guest lecture?

Responses	(percent)	(count)
Didn't understand the questions	12.50%	9
<b>Didn't know the answers</b>	<b>41.67%</b>	<b>30</b>
Had answers but they were incorrect and I was happy I hadn't responded	5.56%	4
<b>Had correct answers, but wasn't sure enough to respond loudly</b>	<b>34.72%</b>	<b>25</b>
Had correct answers but chose not to respond	5.56%	4
<b>Totals</b>	<b>100%</b>	<b>72</b>

## Request for incorporation of EVS into more lectures



This report describes the first time the lecturer, and over 95% of the students (figure 15), had used EVS technology. Overall, the students were very positive in their assessment of the EVS indicating that they looked forward to using the EVS in lectures ( $2.0 \pm 0.1$ , figure 16) and that they would recommend the incorporation of EVS questions into other lectures ( $1.7 \pm 0.1$ , figure 17). Publication of this information will be used to promote the use of EVS technology in lectures in our School which will hopefully enable us to further investigate the effectiveness of the EVS process for learning outcomes.

93.6% never used,  
90.1% recommend,

# **Conclusions**

- **Adding EVS to lectures resulted in**
  - **Positive student experience**
  - **Increased perception of understanding**
  - **Feeling of active involvement in lectures**
  - **Request for EVS in more lectures**

## **Future directions**

- **Increase the use of EVS in teaching**
- **Investigate the effects of EVS on learning outcomes**
  - **Relate responses to exam performance**
- **Use EVS as a *tool* for investigation**
  - **Determine prior knowledge**
  - **Determine underlying learning difficulties**
  - **Measure the learning outcomes of changes to teaching method**

Performance for EVS questions associated with performance on exams  
Kennedy & Cutts 2004

## **Increasing use by lecturers**

- **Equipment setup and portability**
- **Distribution of software**
- **Publicise availability and applicability**
- **Technical support and workshops**

23 attended, 12 lecture large groups plus 1 tutors large groups

21 had briefly investigated – never heard of it before (14 heard in passing – never heard)

15 didn't know we had a system and 12 of these rated it as useful – extremely useful, all agreed that workshops would be useful

As more people use the EVS, hope to collect feedback on what works and what doesn't to continually refine the teaching method

## Lessons from the literature

- **87% students believe there were more advantages than disadvantages**
  - Long history of technical difficulties
- **Must not waste lecture time**
- **Must address a learning objective**
  - Design questions for specific learning outcomes
- **Must have time to address responses**

Draper and Brown 2004

### **Draper and Brown 2004**

In the initial two-year period, eight different departments from psychology to computing science, from philosophy to medicine, with first year and fourth year students, and in group sizes from 12 to 300. Usage varied greatly from single-hour uses to routine use in a 20 lecture course, repeated and improved every year for three years.

Need reason for using it

Needs to be efficient

Students require some training

Responses need to be acted on

Can promote discussion

what doesn't work:

Q's flash up too quick

Tech problems (staff and equipment) – restart

Negative comments to students by other lecturers

**Questions?**