



# Software Engineering Exams – the influence of multiple-choice questions (MCQs)

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Bansko, Bulgaria, 26 – 31 August 2013



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- Overview
- Three types of examination questions
- The influence of different assessments for MCQs
- Only MCQs?
- Conclusions



## Overview of SE exams at HU

criterion		WS 12/13	WS 11/12
basis	time	120 min.	
	points	180	
number of	tasks		43
	subtasks		64
number of students	accepted		101
	registered		87
	participated		81

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## The main results in 2013

### Scale

Mark	1,0	1,3	1,7	2,0	2,3	2,7	3,0	3,3	3,7	4,0
Points	153,0	144,0	135,0	126,0	117,0	108,0	99,0	90,0	81,0	72,0
%	85,0	80,0	75,0	70,0	65,0	60,0	55,0	50,0	45,0	40,0

1,0 – best grade: excellent  
4,0 – just passed  
5,0 – failed

### Results



- 64 students passed
- 7 students failed
- Average grade: 2,64

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## Types of questions in 2013: 3 times more multiple choice than in 2012

year	critierion	knowledge	multiple choice	skills	overall
2013	quantity (subtasks)	35		15	65
	possible points	72		64	180
	amount %	40		35,6	
2012	quantity (subtasks)	45		14	64
	possible points	97		68	180
	amount %	53,9		37,6	

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## New in 2013: negative points for wrong answers

10. (3 points) On which basis cost estimation for software projects is possible?

- a) Preliminary requirements specification  yes  no
- b) Requirements specification  yes  no
- c) Use Case Diagrams  yes  no
- d) previous projects  yes  no
- e) Division of a system to sub-systems  yes  no
- f) Information of the portion of a special phase as part of the whole system development  yes  no

### Assessment 2013:

- 0.5 points for each correct answer
- -0.25 points for a wrong answer

**Reason: to prevent students from guessing answers**

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## Results in 2013: less points for multiple choice questions

2013					2012				
critereon	knowledge	multiple choice	Skills	overall	critereon	knowledge	multiple choice	Skills	overall
quantity (subtasks)	35	15	15	65	quantity (subtasks)	45	5	14	64
possible points	72	44	64	180	possible points	97	15	68	180
average points %	65,2	63,0	63,1		average points %	62,4	62,8	63,1	
min	3,5	6	9	34	min	11	5,5	17	38
max	70	41,5	64	168,25	max	92,5	14	63	162

**Reason:  
negative points**

MCQs with negative points:  
assessment below the overall average  
MCQs without negative points:  
assessment above the overall average

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## Three different assessments for MCQs



- Negative points for wrong answers (2013)
- Zero points as a lower limit for all MCQs (i.e. never negative points in the total)
- Zero points for wrong answers (2012)

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## Example for 3 possible assessments of MCQs

Assume: correct answers always „yes”



option number	Student answers		points 2013	Modification 1	Modification 2 (like 2012)
	yes	no	(penalty)		(bonus)
1	x		1	1	1
2		x	-0,5	-0,5	0
3		x	-0,5	-0,5	0
4		x	-0,5	-0,5	0
5			0	0	0
		<b>total</b>	<b>-0,5</b>	<b>0</b>	<b>1</b>

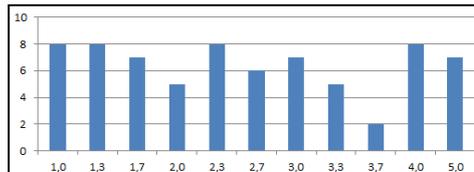
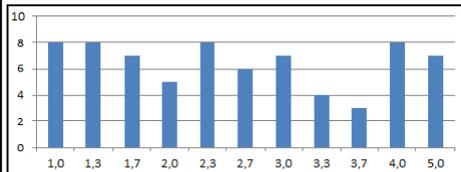
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## Modification 1: What happens if we use assessment zero points instead of negative points for multiple choice?

with reduction  
(negative points possible)

with 0 points instead negative points



1,0	1,3	1,7	2,0	2,3	2,7	3,0	3,3	3,7	4,0	5,0	ø
8	8	7	5	8	6	7	4	3	8	7	2,64

1,0	1,3	1,7	2,0	2,3	2,7	3,0	3,3	3,7	4,0	5,0	ø
8	8	7	5	8	6	7	5	2	8	7	2,63

- 34 of 71 students would get more points (0,25...2,75)
- but only 1 Student would get a better grade

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## Modification 2: What happens if we use assessment without reduction for multiple choice?

### 2013 multiple choice

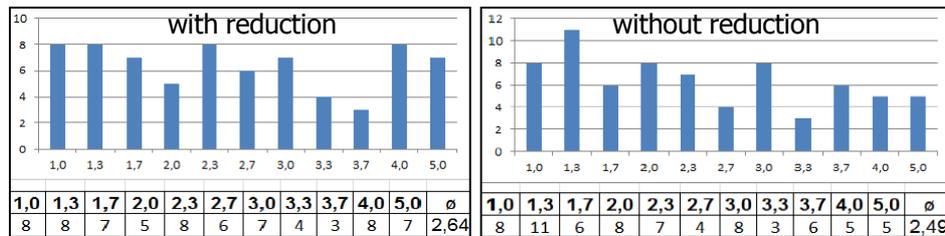
critierion	with reduction	without reduction	2012
possible points	44	44	15
average points %	59,4		

We would get nearly the same result as in 2012

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## Main results for modification 2 would be much better



- all students would get more points (0,25...9,0), in average 4,5 points
- **28 of 71 students** would get a better grade (!)
- average: 2,49 instead of 2,64 (!)

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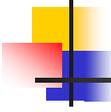
## Comparison between good, middle and bad student-groups

students	Number of additional points in case of no reduction			average points %		number of better marks
	min	max	∅	with reduction	without reduction	
10 best	0,25	4,50		83,6	87,4	0
10 worst	3,25	8,50		35,6	48,8	2
10 middle	2,25	7,50	5,36	55,5	67,7	
all	0,25	9,00	4,57	59,4	69,8	28

- better students get only few points more
- worst students would get most additional points
- students in the middle would have most profit

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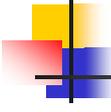
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## Exams completely based on MCQs

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### Why?

- Advantage: MCQs easier and faster to correct
- MCQs can be corrected by non-professionals or automatically
- Question: Will an exam completely based on MCQs properly reflect students performance?

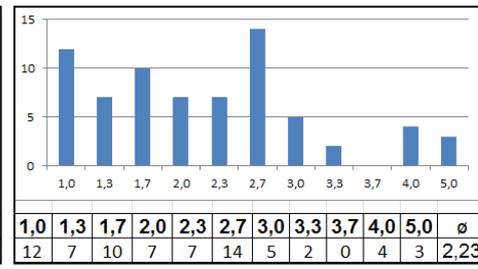
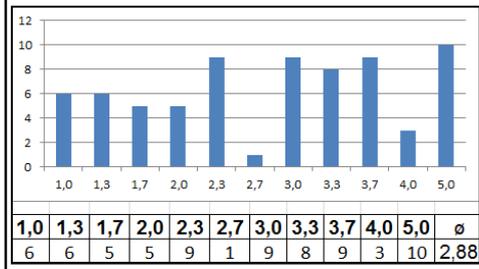


# What happens if we use only MCQs?

(Base: 15 questions 2013, same scale as shown at the beginning)

with reduction (penalty)

without reduction (bonus)



The result is strongly determined by the kind of assessment – in each case: MCQ exams acceptable



# What happens if we use only MCQs?

with reduction?	only MCQs			∅	overall
	better	worse	equal		
yes	15	39	17	2,88	2,64
no	35	14	22	2,23	2,49

→ **With reduction: MCQs lead to worse results**  
 Without reduction: MCQs lead to better results

## What happens if we use only MCQs?

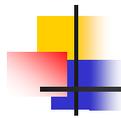
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With reduction: MCQs lead to worse results

→ **Without reduction: MCQs lead to better results**

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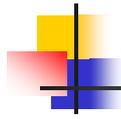


## Conclusions

- There are many references about using MCQs
- For instance in /2/ we find a good historical overview and some reflections for writing good multiple-choice tests, /3/ presents a checklist for writing effective MCQs ... and so on
- Writing good multiple-choice tests is difficult

/2/ Simon: Wrong is a relative concept: part marks for multiple-choice questions. Proceedings of the 13<sup>th</sup> Australasian Computing Education Conference (ACE 2011), Perth, Australia, January 2011. CRPIT, Vol. 114, S. 47-53

/3/ Woodfort, K., Bankroft, P.: Multiple Choice Questions Not Considered harmful. Proceedings of the 7<sup>th</sup> Australasian Computing Education Conference (ACE 2005), Newcastle, Australia. CRPIT, Vol. 42, S. 109-115



## Conclusions

- An additional problem we offer in this presentation: The bonus-penalty kind of assessment
- The **bonus assessment** leads to significant better results: if we would have used it in 2013 instead of the **penalty assessment** 40% of the students would get a better grade (!)
- For better students the type of assessment is insignificant, **most profit** from the bonus assessment would have **students with mean accomplishments**



## Conclusions

- The bonus assessment allows guessing answers, but the penalty assessment is disputed in Germany (action at law are possible) /4/
- Students at Germany called a court because of the penalty system. The court gave them right and prohibited negative points. Reason: Positive points (positive knowledge) will be neglected by wrong answers at other questions.

/4/ <http://www.pflichtlektuere.com/16/05/2012/multiple-choice-verwirrung-um-minuspunkte/>



## Conclusions

### Thank you for your attention!

#### References

- /1/ Ritzschke, M.: Software Engineering exams of Bachelor students - some conclusions. 12th DAAD-workshop "[Joint Course in Software Engineering](#)". Opatija, Croatia, September, 3rd - 8th 2012. [Paper \(pdf\)](#)
- /2/ Simon: Wrong is a relative concept: part marks for multiple-choice questions. Proceedings of the 13<sup>th</sup> Australasian Computing Education Conference (ACE 2011), Perth, Australia, January 2011. CRPIT, Vol. 114, S. 47-53
- /3/ Woodfort, K., Bankroft, P.: Multiple Choice Questions Not Considered harmful. Proceedings of the 7<sup>th</sup> Australasian Computing Education Conference (ACE 2005), Newcastle, Australia. CRPIT, Vol. 42, S. 109-115
- /4/ <http://www.pflichtlektuere.com/16/05/2012/multiple-choice-verwirrung-um-minuspunkte/>