Quizzes or Exams, Which one Should be More Challenging?

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***Abstract*— Current experimental study targets the following fundamental question: Which exam is the optimal place to include challenging questions during the course assessment: quizzes, midterm exam(s), and/or final exam? The paper presents a comparative study which verifies that having harder quizzes during the semester helps students (a) to motivate them to improve their knowledge by earlier facing and tackling with challenging questions, (b) to have reasonable period of time to improve, with the minimum missed marks (less academic record damaging), (c) to achieve a higher mark for the course. Results and study procedure are provided for two courses, namely, Introduction to Programming and Software Design II courses.**

I. Introduction

The provided experimental results in this paper are based on conducted studies at the University of Ontario Institute of Technology (UOIT) on first year and second year courses, namely, Introduction to C++ Programming for Engineers and Software Design II (for Software and Mechatronics engineering students), respectively. Details about the experiments and corresponding numerical results are provided. Demonstrated conclusion remarks are not limited to undergraduate programs, in fact, the idea can be extended to high schools, colleges, and even to graduate programs, subject to properly consideration of some circumstances.

The paper is organized as follows: Section II discuses results about study on Introduction to Programming course, numerical results and result analysis for Software Design II course are provided in Section III, and finally the paper is concluded in Section IV.

II. Study on Introduction to Programming for Engineers Course

During teaching the Introduction to Programming course in 2009, there were eight easy quizzes with ten multiple-choice questions for each and 20-25 minutes time duration per quiz. For Winter semester 2010, the quizzes were made very challenging (let's call them take-home multiple choice exams instead), the duration and the number of questions are summarized as follows:

Quiz no. <duration (min.s), number of questions>
Q1<35,25>, Q2<85,50>, Q3<80,50>, Q4<80,45>, Q5<80,50>, Q6<80,50>, Q7<80,60>, Q8<90,55>.

For both years, the quizzes were considered as 8% of the course total mark. The students were from the same faculty (engineering); also the number of the students were almost the same (114 in 2009 and 116 in 2010). The numerical results and histograms for Quizzes 1-8 and Midterm Exam for this course are given in Fig. 1 and Fig. 2 for 2009 and 2010, respectively. The corresponding average and median marks comparisons are provided in Fig. 3.

As seen, for the majority of the quizzes, students did better with easy quizzes in terms of the average and median marks, but for the midterm exam, the students could obtain much higher mark when they experienced the challenging quizzes in 2010 (Ave: 56.9%, Med: 54.5% for 2009 vs. Ave: 68.9%, Med: 73% for 2010) . It is interesting to mention that, the midterm exam for 2010 was even much more harder than the previous year's.

III. Study on Software Design II Course

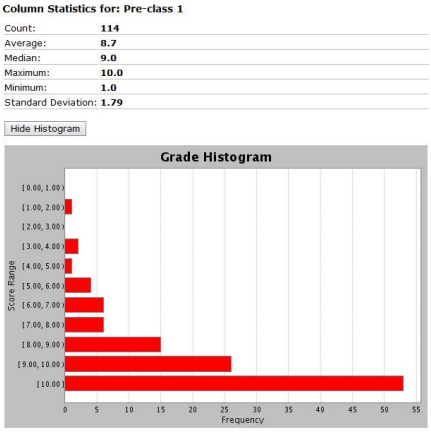
In 2009, this course didn't include any quizzes. In Winter 2010, nine challenging quizzes with a total value of 9% were added on course outline; the duration and the number of questions for them are summarized as follows:

Quiz no. <duration (min.s), number of questions>
Q1<25,15>, Q2<25,30>, Q3<25,25>, Q4<15,15>, Q5<40,45>, Q6<40,40>, Q7<25,20>, Q8<20,25>, Q9<25,35>.

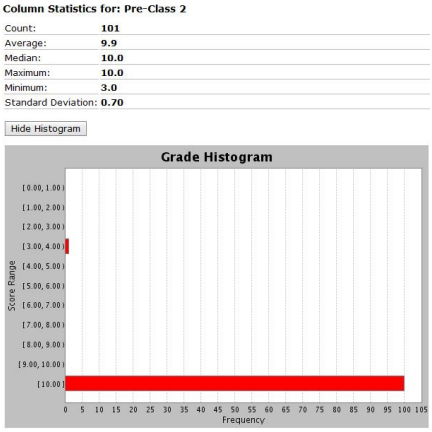
The numerical results and histograms for Quizzes 1-9 for this course are shown in Fig. 5. The numerical results and histograms for Midterm Exams for 2009 (no quizzes) and 2010 (challenging quizzes) are given in Fig. 4. As seen, similar to the programming course, the students got much higher mark when they experienced the challenging quizzes in 2010 (Ave: 73.4%, Med: 73.5% for 2009 vs. Ave: 81.5%, Med: 82.5% for 2010).

IV. Concluding Remarks

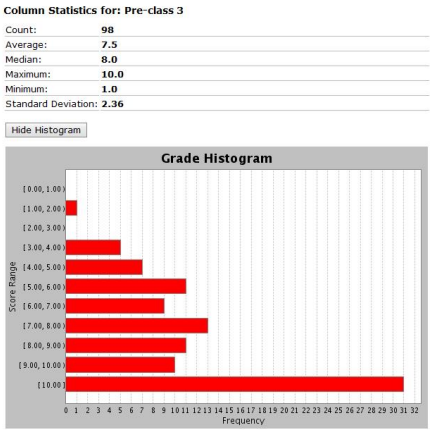
The benefit of having challenging quizzes during the semester was verified on two courses at UOIT. A very similar results are observed on the Computer and Security course but its results are not reported in this paper. Hard quizzes have two valuable achievements: learning better by earlier confrontation of the challenging questions and improving the course overall mark; all is achieved just by challenging students over less than 10% of the course total mark.



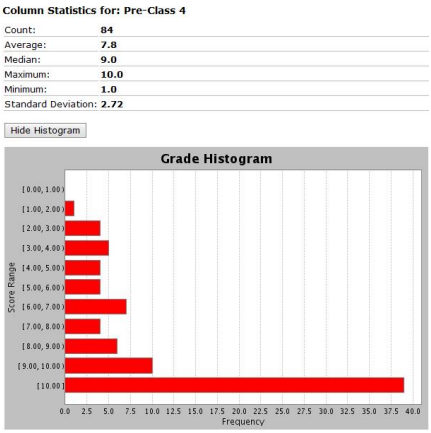
(a) Quiz 1, 2009



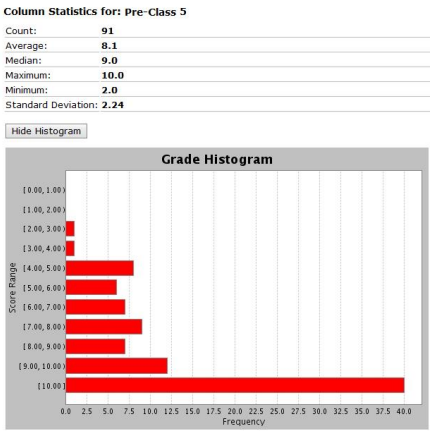
(b) Quiz 2, 2009



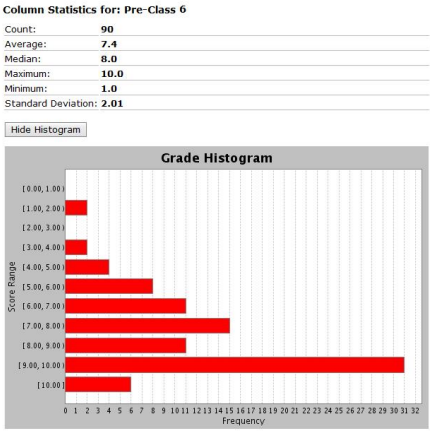
(c) Quiz 3, 2009



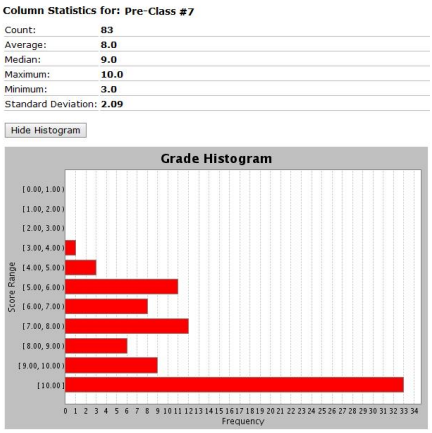
(d) Quiz 4, 2009



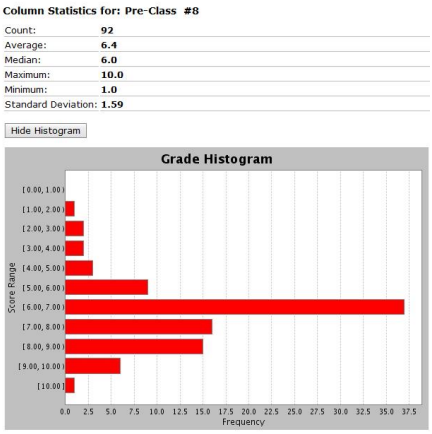
(e) Quiz 5, 2009



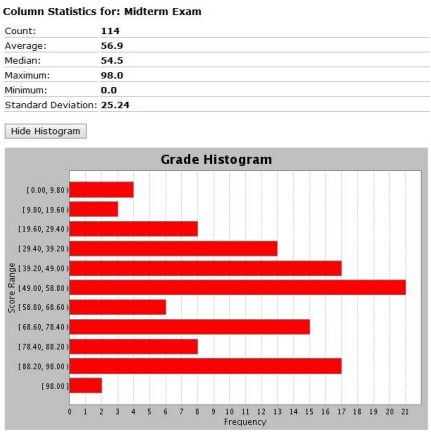
(f) Quiz 6, 2009



(g) Quiz 7, 2009



(h) Quiz 8, 2009



(i) Midterm Exam, 2009

Fig. 1. Numerical results and histograms for Quizzes 1-8 and Midterm Exam for Introduction to Programming course in 2009.

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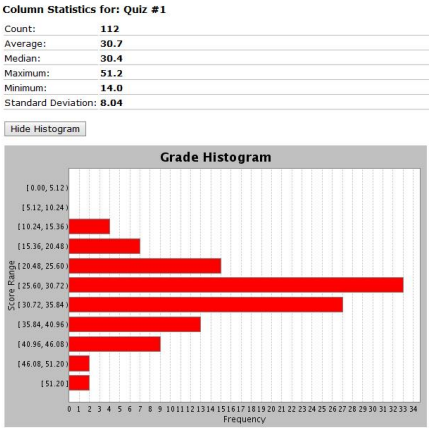
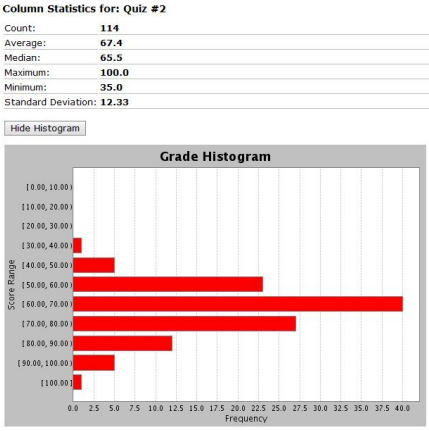
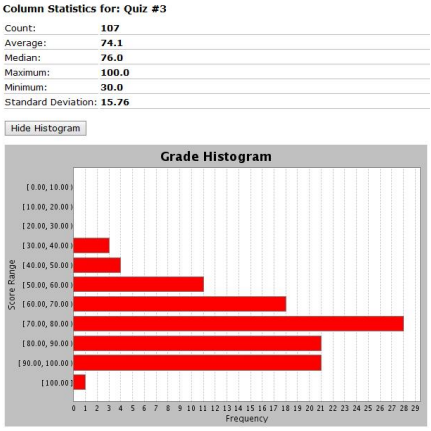
[1] E. Jane Davidson, *Evaluation methodology basics: the nuts and bolts of sound evaluation*, Sage Publications Inc., 2005, ISBN:0-7619-2929-0.



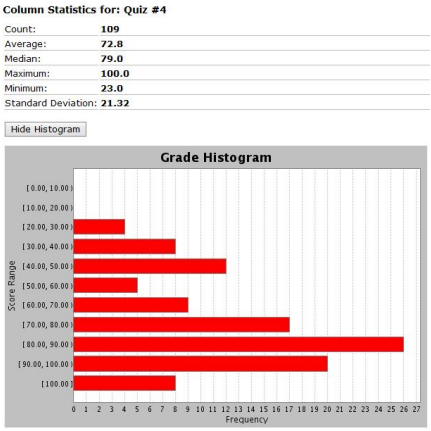
(a) Quiz 1, 2010



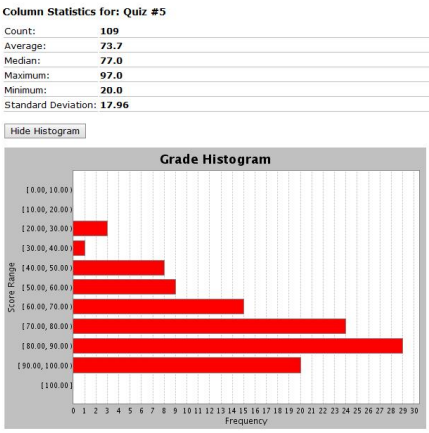
(b) Quiz 2, 2010



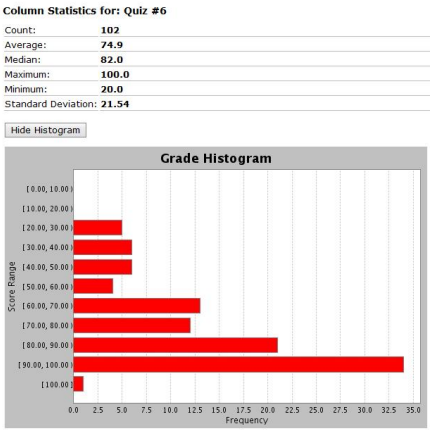
(c) Quiz 3, 2010



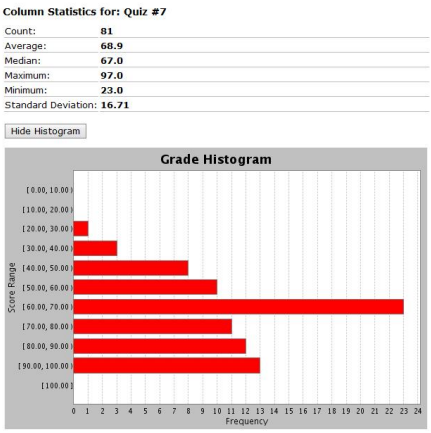
(d) Quiz 4, 2010



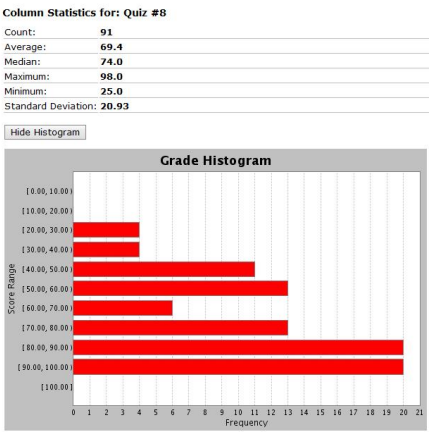
(e) Quiz 5, 2010



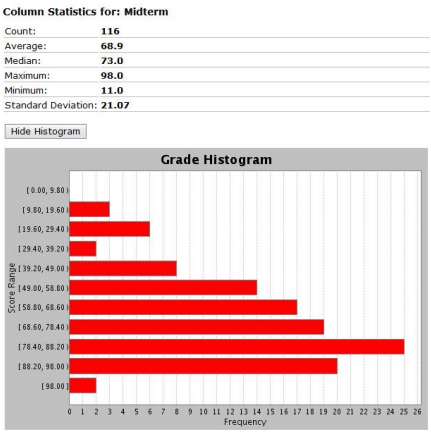
(f) Quiz 6, 2010



(g) Quiz 7, 2010



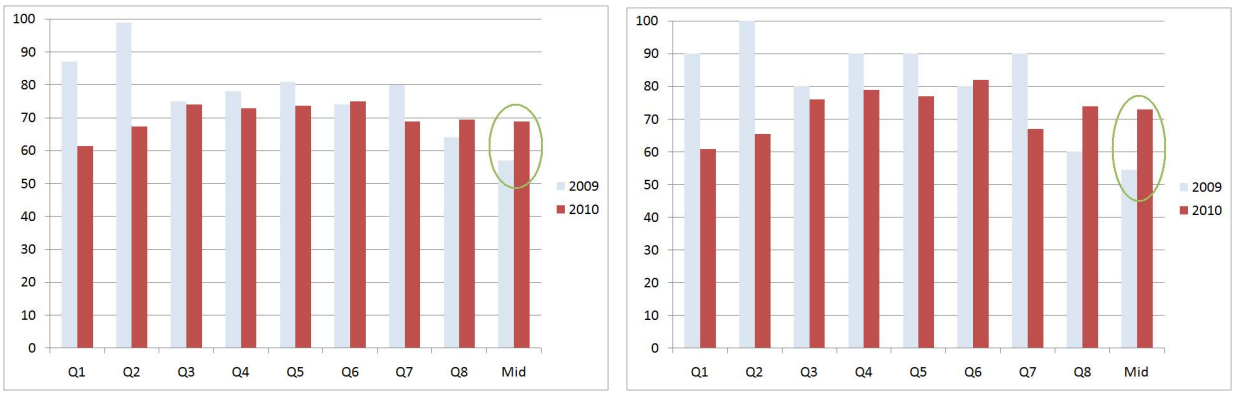
(h) Quiz 8, 2010



(i) Midterm Exam, 2010

Fig. 2. Numerical results and histograms for Quizzes 1-8 and Midterm Exam for Introduction to Programming course in 2010.

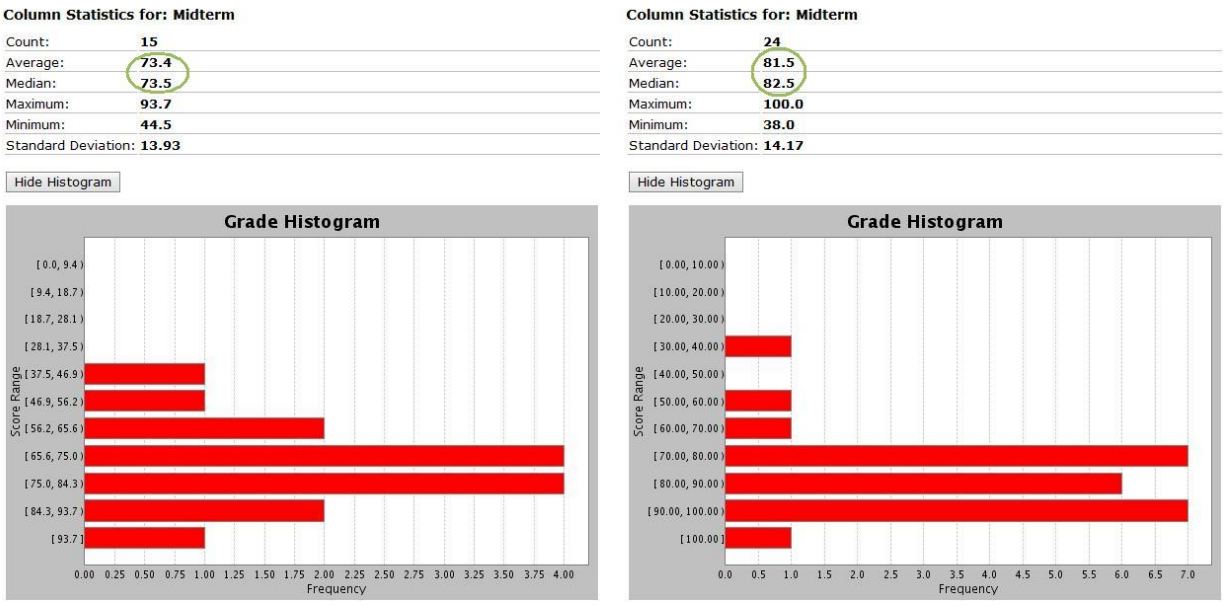
[2] , Linn Robert L., *Measurement and Assessment in Teaching*, Pearson Education, 2009, ISBN:8131720756.



(a) Comparing of average marks of Q1-Q8 and Midterm Exam for 2009 and 2010.

(b) Comparing of median marks of Q1-Q8 and Midterm Exam for 2009 and 2010.

Fig. 3. Average and median marks comparison for Introduction to Programming course in 2009 (easy quizzes) and 2010 (challenging quizzes). The difference between midterm marks is illustrated by an oval.



(a) Midterm Exam for Software Design II in 2009.

(b) Midterm Exam for Software Design II in 2010.

Fig. 4. Numerical results and histograms for Midterm Exams for Software Design II course in 2009 (no quizzes) and 2010 (challenging quizzes).

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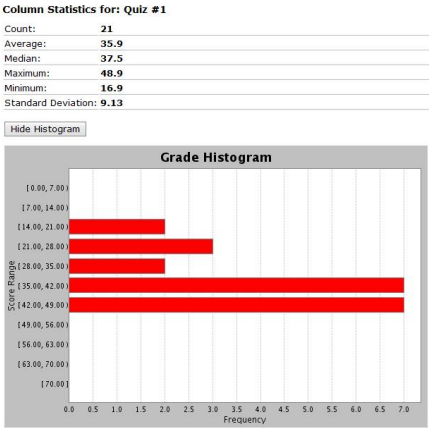
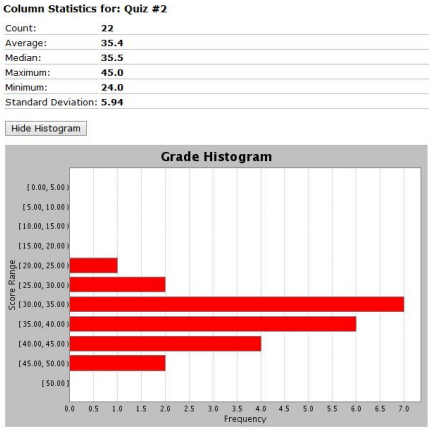
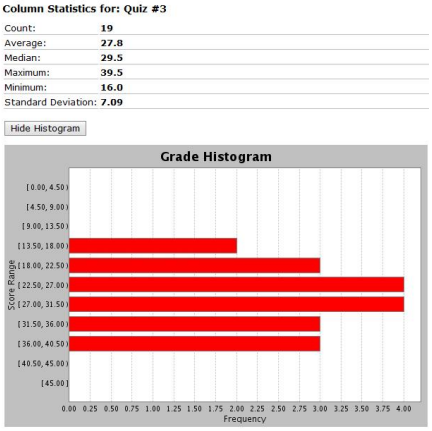


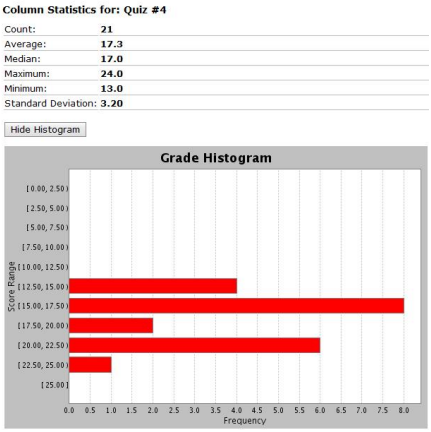
(a) Quiz 1, 2010



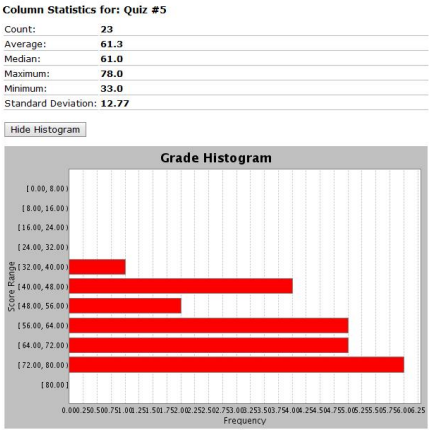
(b) Quiz 2, 2010



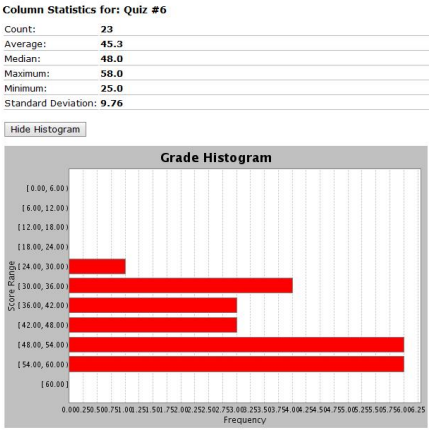
(c) Quiz 3, 2010



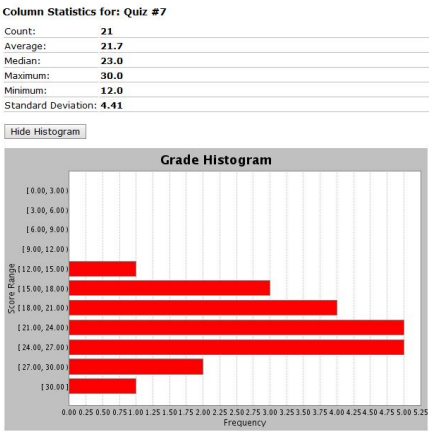
(d) Quiz 4, 2010



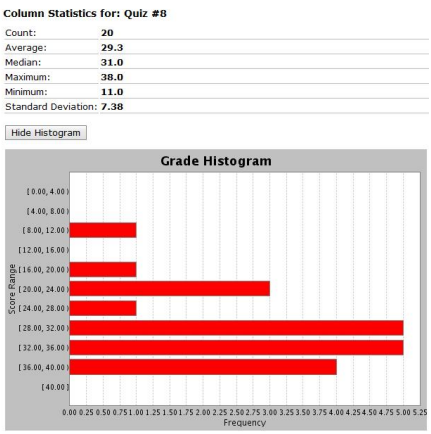
(e) Quiz 5, 2010



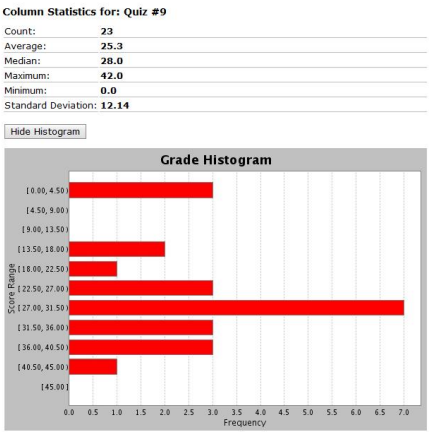
(f) Quiz 6, 2010



(g) Quiz 7, 2010



(h) Quiz 8, 2010



(i) Quiz 9, 2010

Fig. 5. Numerical results and histograms for Quizzes 1-9 for Software Design II course in 2010.