

# SYSTEM OF INDIVIDUAL TESTS FOR LARGE UNDERGRADUATE CLASSES

Jana Wichterlová<sup>1</sup> and Kamil Wichterle<sup>2</sup>

**Abstract**  $\frac{3}{4}$  Common way of examination is an interview with the student, which is a time consuming procedure in large classes. Multiple-choice question tests, as a part of exam, can help solve the problem. Prevention of copying during the exam is exhausting and unworthy. It can be overcome by individual tests. The manual evaluation is slow for several tens of individual tests daily. Therefore we developed a transparency which is matched with the answer form. Shifting and rotation of the transparency according to the test number makes also the answer keys individual and the code cannot be simply cracked. Application of the tests have been proved to be an efficient part of the examination of 800-1200 students in any term in chemistry during last two years.

**Index Terms**  $\frac{3}{4}$  Multiple choice questions tests, individual test, evaluation of tests.

## INTRODUCTION

Usual form of exam in our country is an interview with a student. There are several hundred students in a course per examiner in undergraduate classes. It is evident, that exams are very time consuming procedures.

Therefore, it is advantageous, when an exam has a written part consisting of multiple-choice question test. Number of objections has been raised against the multiple-choice question tests. Nevertheless, we realized that they may provide an important information on the student's insight of all subjects in chemistry. Passing the tests is the necessary condition for starting the interview where ability to apply the knowledge for solution of particular problems is examined.

It is easy to prepare tests to a definite time in a definite space for a single group of students. This is not a situation typical in large undergraduate classes. We have succeeded to solve problems connected with application of the tests under these specific conditions. Probably, similar problems may occur in other places too, so we like to share our experience.

## PROBLEMS OF LARGE CLASSES

- Time: the examinations take place regularly five days a week for more than one month. Therefore, the tests have to be changed to maintain equal conditions for all students.

- Space: Chemistry is taught in various places within the university campus and also in other buildings in distant places. Large auditorium for exams may not always be available; in smaller rooms there is problem of copying when identical tests are solved.
- Staff: Number of proctors in the department is limited.
- Computers: Facilities for on-line computer testing are available, however the Department of Chemistry cannot occupy the computer rooms in the extent, which is demanded for efficient testing of all students.

## SOLUTION - INDIVIDUAL TESTS

The problems can be overcome by individual multiple-choice question tests, which can quickly be evaluated. Then any student solves his own set of questions.

When the bank of questions is available, a computer program can simply select a random set and to evaluate on-line the answers. A computerized form of testing seems to be the most suitable, but today we cannot use it (deficit of PC in our department, dislocation of some courses with inaccessibility of appropriate hardware). Furthermore, when the test are transferred to dislocate computers with floppy discs, the programs are more vulnerable to be cracked. There are competitive hackers among our students.

Off-line testing needs a reading hardware, availability of it is limited to special PC stations. On the other hand, manual evaluation of a great number of individual tests is intolerably sluggish. In this contribution a new approach to the problem is presented. Set of several tens of individual tests is formed which can be quickly manually evaluated by using a single transparent sheet. Our combination: individual test - transparency set to various positions of answer form, does not allow the sequence of right answers to be memorized.

The test system consists of:

- the transparency (one or more),
- set of tests (loaned to students solely for the test time - in such a case, identical question sheet can be reused for other groups of students),
- answer sheet form where the student writes down the answers, test number, date and signature.

Strictly individual tests prevent copying and cheating during written exam. It makes the examination less stressing for proctors, and the results are more reliable.

<sup>1</sup> Jana Wichterlová, VSB-Technical University Ostrava 70833 Ostrava Poruba Czech Republic, wih47@vsb.cz

<sup>2</sup> Kamil Wichterle, VSB-Technical University Ostrava 70833 Ostrava Poruba Czech Republic, wih15@vsb.cz

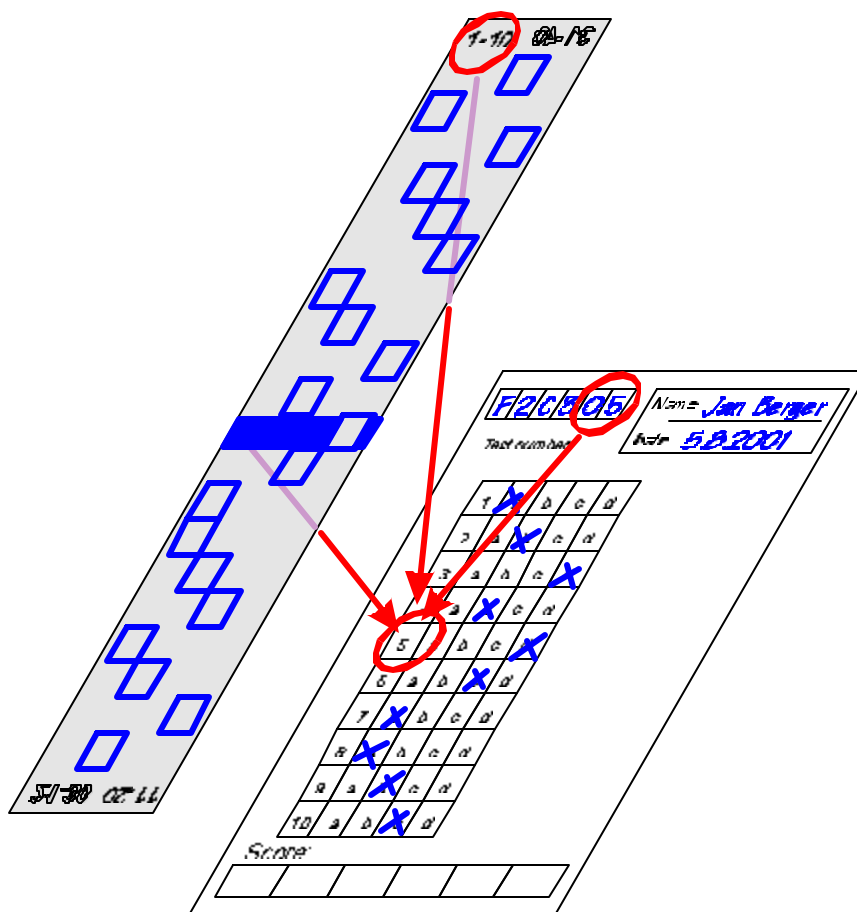


FIGURE. 1

APPLICATION OF A TRANSPARENCY TO THE ANSWER FORM WITH THE RIGHT ANSWER CODE.

### TRANSPARENT SHEET FOR EVALUATION OF THE TESTS

A sequence of drawn windows on a transparent sheet (Fig.1) is prepared by employing a random number generator. In such a way, different transparencies can be produced, each is identified by the transparency number. The transparency is matched with the answer sheet form. It can be placed to one of several tens positions including left right and upside-down mirroring and rotation.

The transparency number and the position of the transparency on the answer sheet form define right answers.

Any test has its test number, which characterizes:

- number of transparency,
- number of the position of transparency on the answer form,
- eventually, additional set of digits and letters.

A simple example is demonstrated in Fig.1. We can see a filled answer form, here with 10 right answers. A teacher can read from the test number several informations. Here in non-encrypted form appears the digit 3, (number of the transparency) and a couple of digits 05. The combination 0

and 5 means, that the respective transparency should be placed by the marked (blue) row to the answer 5. Number of tests evaluated by one transparency can be easily extended with the transparency in the left-right and upside-down rotation. For example, combination of digits 1 and 4 means, that the marked row is placed to the answer 4 with the transparency in upside-down position and other numbers are for the backside of the transparency. In this way, not only the set of 40 different answer keys is obtainable, but also the order of answers cannot be simply unlocked.

Our common tests contains usually either 20 or 40 questions, both the answer forms and transparencies are organized into two columns, however the rules of their application is similar.

In principle, the system can be modified to contain more than one right answer to the selected number of questions. When you like, you can also encrypt the code number by the additional set of digits and/or letters.

Unlimited number of transparencies can be used. However, by our experience a few pieces may be satisfactory. We recommend to change time to time the transparency, the respective stack of tests need not be discarded, it can be again used after some period.

## PROCEDURE OF THE TEST GENERATION

*Select: Structure of the test (A)*

(i.e. requested number of questions from particular chapters)

*Select: Number of the transparency (B)*

*Set: Position of the transparency  
on an answer form (C)*

*result: Code number of right answers (B,C)*

Random selection of given number  
of questions from given chapter

Next chapter

*result: Set of questions with the structure (A)*

Random permutation of questions

*result: Randomly ordered set of questions*

Placement right answers  
to the places defined by the code number (B,C)

Placement wrong answers in random order  
to the other places

*result: Randomly ordered set of questions and answers*

Transfer of the results to a text file

*result: Test sheet with the code number (B,C)*

*Saving*

*Printing*

Next test

## GENERATION OF INDIVIDUAL TESTS

As obvious, the essential problem is always preparation of the worthwhile examination questions. A database of

questions with fixed number of ordered true and false answers should be put together. It contains subjects covering all chapters of chemistry in our case.

Then it is necessary to define the structure of tests, i.e. total number of questions or number of questions related to particular chapters.

The following preparation of individual questions-and-answer test sheets is algorithmized and we can simply prepare any number of different tests for the price of printed paper. Method of random variation from the larger set of questions and random ordering of the questions in particular test sheets, cause low probability of incident occurrence of the same question in the tests of neighbor students in a classroom. Even in that case, true answers belong to different letters. The permutation of wrong answer may be confusing as well. Looking to the answer form of a good student cannot help you much even in the case when you have cracked the principles of manipulation with a transparency. It makes copying quite inefficient, and by our experience students resign to read something from other result forms.

## CONCLUSIONS

Advantages of the above mentioned individual multiple-choice question tests are:

- they are strictly individual
- they are fast and easily evaluated (100 tests per hour)
- their evaluation is not tied up with PC
- they give rapid orientation, in which parts of the subject has the student problems with understanding the stuff, and how deep is his ignorance; then the information can be with advantage used to fasten a verbal part of exam
- in practice, the key of the right answers is hardly discovered. If there may be some leak (e.g. if the transparency is lost, set of test may be simply substituted by a set with a quite different codes.

In our university, the tests are used as a part of exam in general (and to some extent in descriptive) chemistry for two years and it proved to be efficient and helpful at examination nearly one thousand students in any course.

During this time our database has been systematically extended. Creation of imaginative questions and precise answers is also a good challenge for the members of our staff.