A problem-solving format for written examinations in veterinary clinical subjects

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A simple format for a problem-solving written examination for testing students in clinical subjects was devised. A clinical problem was divided into several parts, which were described on separate pieces of paper. Students answered one part at a time, and then proceeded to the next part on which earlier relevant information was retained. The format requires students to recall, collate, analyse, interpret and synthesise information; it has been used successfully for seven years, and has potential as a teaching method.

It is difficult to assess accurately the 'total clinical competence' of students studying veterinary medicine, because 'total clinical competence' comprises the amount and accuracy of factual recall, the ability to 'process' information, the ability to perform techniques and the ability to take appropriate action.

The 'processing' of information includes its collection, collation, analysis, interpretation and synthesis; together with the amount and accuracy of factual recall, it constitutes the basic mental skill necessary for a competent performance in clinical subjects. Total clinical competence also requires practical skills, ranging from basic diagnostic techniques such as auscultation of the heart or collection of a blood sample, to more sophisticated procedures such as surgery. Finally, the ability to take appropriate action combines both 'intellectual' and 'practical' components. It requires the knowledge of where information can be found, the ability to organise the investigation of a problem, and the less tangible but nonetheless important ability to inspire confidence in clients and motivate them to take action.

Traditionally the clinical competence of students has been assessed by observations of their performance in real or mock clinical situations, or by the assessment of their responses to written and oral questions. Projects, assignments, reports, tutorials and seminars are variations on these basic techniques. However, none of these methods alone adequately assesses all the components of total clinical competence and combinations are therefore generally used. Observation of performance provides the best coverage of total clinical competence but in recent times it has lost favour because it can be more subjective than other methods, and, rightly or wrongly, apparently objective assessments are considered more desirable than subjective assessments.

In many veterinary schools increasing use is being made of written examinations, and there is even a tendency to shift from more subjectively marked 'essay questions' to more objectively marked 'multiple-choice questions'. However, written examinations alone cannot accurately assess the practical ability of students in clinical subjects, and their emphasis on factual recall fails to assess a student's ability to 'process' information.

To overcome these deficiencies new assessment methods have been developed. In human medicine simulation techniques have used professional actors as patients—a technique not yet applicable to veterinary medicine! Newbile (1977) and Harden and Cairncross (1980) have described developments which greatly improve 'observation of performance' as an assessment method. For example computer simulation can be applied to real-life problems.

Simulation has also been incorporated into written examinations. Newbile (1977) called these 'paper simulations': In human medicine, Rimoldi (1963) developed a 'diagnostic management problem' which was adapted to a 'patient management problem' (McCarthy and Gonnella 1967, McGuire and Babbott 1967). A critical disadvantage of the patient management problem is the effect of cueing. The 'sequential management problem' avoids cueing (Berner and others 1974). Another approach is the 'modified essay question' (Hodgkin and Knox 1975). Newbile (1977) stated that the patient management problem or its variants must be regarded as experimental until more data on reliability and validity are available. Despite the limitations, the technique has great potential for evaluating at least some aspects of clinical performance and is a useful and practical adjunct to objective (multiple choice) 'tests'.

References

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Objective

Multiple-choice questions can be marked more objectively than essay questions but neither question style alone can reliably assess a student’s ability to collect, collate, analyse, interpret and synthesise the type of information used by clinicians when making diagnoses and solving problems.

The objective was therefore to prepare a written examination paper that would include the objectivity of multiple-choice or short answer questions, assess the ability of the student to analyse, interpret and synthesise information as well as to recall, present a problem in a manner and a chronological sequence similar to that likely to be encountered in practice, and test as broad a range of subject matter as possible, while remaining relatively easy and inexpensive to prepare, conduct and mark.

Results

Format

The examination paper is divided into four to five parts and the students record their answers on the paper itself. They are initially given only part A of the examination paper. When part A is completed to their satisfaction they raise their hand and the supervisor brings them part B and collects part A. On the completion of part B it is exchanged for part C, and so on until all parts of the paper have been completed, or until the examination period has expired. Once a part has been handed to the supervisor it cannot be retrieved by the student.

Students work at their own pace and do not have to exchange parts at the same time as other students. At the beginning of the examination they are informed of the total time available and the percentage mark allocated to each part of the paper so that they can allocate the appropriate amount of time to each part. The value of each question appears alongside the question. Two examination supervisors can cope with 50 students.

Content

The whole examination paper contains 10 to 20 multiple-choice or short-answer questions which are not evenly distributed among the parts, and are not of equal length or value. The main criteria for the allocation of marks to a question are the estimated time required to prepare the answer to the question, and the importance of the content of the question relative to other questions.

Each new part of the paper contains information from the previous part(s) which is relevant for the questions in the new part, plus additional information which a veterinarian would have received from answers to the questions in the previous part, plus any new information which it is necessary to include to enable the student to ‘investigate’ the problem in the paper.

The paper usually begins with a description of a problem such as might occur in practice, eg, ‘Your examination of last week’s herd performance figures from a client on your pig herd health and production programme reveals that the preweaning mortality rate was 19.6 per cent. The target figure is 12.5 per cent’. This is followed by questions which require the student to state what additional information would be needed to find out whether the increase in preweaning mortality has existed for long enough or is large enough to require investigation. This information may include an evaluation of herd performance figures to detect additional areas of poor production, or ‘leads’ for further investigation, eg, whether there has been a concurrent decrease in the number of recorded stillbirths suggesting that the problem does not exist but that there has been a change in the classification or the timing of recording deaths in the first one to two days of life. Students are encouraged to use calculators if appropriate.

The ‘investigation’ of the problem then proceeds by questions requiring further information, eg, by a visit to the farm, questions to the farmer or other staff, examination of more herd records, inspection of the herd, clinical examination of individual pigs and an evaluation of housing and environment, feeding and nutrition, and husbandry. By this stage students are expected to have provided some idea of the range of possible factors and, or, diseases which might be contributing to the problem, so further questions are designed to test their ability to differentiate between them. Usually in the penultimate part of the examination, the results of clinical examinations, post mortem examinations, and laboratory tests and information on husbandry practices are provided and students are asked for specific diagnoses. The final part questions the students on specific treatments and control, and future prevention strategies for the herd.

Discussion

The concept of providing a problem to ‘work through’ during a written examination is not new, and is widely used in the examination of students of human medicine; the format described in this paper provides a simple and cheap method for problem-solving written examinations for veterinary students.

Other problem-solving examinations exist and will undoubtedly become more useful and widely used. Examples include computer programs which provide and score both correct and incorrect answers, and specially printed papers on which the questions are answered by erasing a cover concealing the answers. However, these formats are relatively expensive in terms of equipment and the time taken to develop them. The format described in this paper requires no additional equipment and little more time than for the preparation of the traditional ‘essay question’ examination paper. The examination needs to be tested on colleagues to check for ambiguities, obscurities and unforeseen possibilities. Examinations from previous years are not made available to students because of the extra time they take to prepare; they are being refined and accumulated to provide a bank of examinations that can be drawn upon as required. However, as students are not exposed to this format earlier in the course, they are given access to several specially prepared sample examinations.

The format has particular application in the assessment of smaller classes, in introductory periods when lecturers and students are familiarising themselves with the problem-solving format, and when inadequate resources prevent more elaborate problem-solving formats. Although used so far only in clinical subjects it is also applicable to non-clinical subjects, and has considerable potential as a teaching method.

The significant aspects of the format are the division of the problem into parts which the students work on one at a time, the exchange of a completed part for the next part and the provision in the later parts of relevant information from earlier parts.

The last provision means that students are not handicapped by their mistakes in previous parts. They are penalised for errors when they occur but they are able to proceed from correct information in the next part, as in veterinary practice when, after dealing with a case, books or colleagues can be consulted. As a result students may learn of their mistakes in previous parts during the examination and their concentration can be affected. Students are warned of this possibility during discussion of the practice problem-solving exercise in a tutorial. They are also informed that even though their answer in the previous part(s) may differ from the information in the current part, their answer may not be entirely wrong and they should not waste time being concerned about it. For example, in the light of the information they had received, several alternative answers might have been equally correct in
the previous part, but because one phase of the investigation has not been included in the examination paper, new information may become available which makes only one of the alternatives correct. Moreover, in real life we are confronted by our mistakes during our work and must learn to cope with them so that they do not hinder our subsequent performance.

The flow of the paper follows the development of an investigation of a problem in veterinary practice. It starts with the presentation of a problem, namely a syndrome or a clinical sign such as 'an abortion', 'more scours than usual', or 'a decrease in weight-for-age at slaughter'. This approach reflects the presentation of the pig medicine and production course at Murdoch University which is based on the differential diagnosis of disease syndromes rather than the traditional approach of learning pig diseases grouped according to aetiology or systems, and also reflects the fact that on farms veterinarians are presented with a problem rather than a disease.

The investigation starts with the quantitative assessment of the problem, ie, the pertinent questions are about the numbers of pigs and the duration of the problem, again reflecting an emphasis in the Murdoch University course. Pig veterinary practice is conducted within the economic framework of pig production and therefore from the outset students must assess the economic effects of the problem and their actions. Too often students reaching the clinical years are trained to establish the aetiology of a problem, at whatever the cost. The emphasis in the paper is on the sorting, collation, and interpretation of information, and on the synthesis of ideas. Thus more time is spent reading and thinking rather than writing. This novel concept of an examination is explained to the students in a preparatory tutorial.

Although problems can be constructed so that they involve several of the syndromes taught in the lecture course, it is not easy with this format, as it is with traditional written examinations or with multiple-choice questions, to span the whole course. However, the advantages of testing a student's ability to cope with an 'on-farm' problem and to provide specific answers to that problem by processing information are considered to outweigh the lack of the rote recall of a greater proportion of the information given in lectures.

The format described in this paper has some inadequacies, but has been used successfully for seven years; it provides a simple and useful additional tool for the difficult task of assessing students in clinical subjects.

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References

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Appendix I

Pig medicine and production problem solving exercise

(JR Budde, 1985)

You have just spoken on the topic 'Abortion In sows to the Narrogin and District Pig Producers Group. At supper a farmer approaches you and says 'I don't have a problem of abortions, but my gilts won't get in-pig. What could be the cause of that?' You reply that it could be any of a number of causes, and in order to find the cause, it will be necessary to obtain further information.

Question 1

In order to decide whether or not an economically significant problem might exist, which of the following is it appropriate to ask the farmer at this point?

a) How long has the problem been present?
b) Have any of the gilts had a discharge from the vulva?
c) Do any nearby farmers have the same problem with their herd?
d) What age are the gilts which have the problem, been bred on the farm?
e) Could he estimate the number of matings per week?
f) Are the gilts housed singly or in groups immediately after selection?
g) How many times a week are the boars used for mating?
h) How many gilts have not 'got in-pig' in the last six months?
i) How many gilts have not been mated in the last month?
j) Could he estimate the number of matings per week per boar?
k) Have the gilts which are not in-pig ever cycled?
l) How many of the gilts in the herd are fitter-mate brothers?
m) How many gilts have not one or two others, although 'they're not aborting', appear to be pregnant, and are down about eight to 18 months, (e) most of them are, (f) creamy discharge last week, (c) 'they're not coming on heat', (d) 'they're not aborting', (g) 'they're not coming on heat', (h) 'they're not aborting', (i) they're not coming on heat, (j) they're not aborting, (k) they're not coming on heat, (l) they're not aborting, (m) they're not coming on heat, (n) they're not coming on heat, (o) they're not coming on heat.

Question 2

To further determine (not diagnose) whether an economically significant problem might exist, which of the following is it appropriate to ask the farmer at this stage?

a) At what stage of pregnancy did the abortions occur in the sows three years ago?
b) Were any samples taken by the local vet from the aborted or premature litters?
c) Were there any mummified piglets in these litters?
d) How many gilts have been mated in the last three months?
e) How many sows are in the herd?
f) Would it be all right if you had another cup of coffee?
g) Does he keep all gilts, which don't get in-pig for 18 months?
h) Have all gilts which have the problem, been examined on the farm?
i) Have all male finisher pigs been castrated or are they entire males?
j) Could he estimate the number of matings per week per boar?
k) Have the gilts which are not in-pig ever cycled?
l) How are the gilts fed once they've been selected?

Part B

A farmer has asked you about the possible cause(s) for his gilts 'not getting in-pig'. During the course of conversation, and another cup of coffee, you ascertain that he has a 100 sow herd. During the last three months he has introduced 10 gilts to the breeding herd, six of which are apparently not in-pig. Four of the 10 gilts are pure-bred large white gilts bought 10 weeks ago at an annual sale in another State, as in-pigs to an imported Duroc boar. These gilts were in addition to his usual herd replacement gilts as he wanted 'to see if these Canadian blood-lines were any good'. Two of the six not-in-pig gilts (both home-bred crossbred replacements) had apparently not come on heat at all. Three of the six are bought-in large white pure-bred replacements mentioned above. The fourth bought-in gilt appears to be pregnant, and is due to farrow in about three weeks. Two of the three not-in-pig large white pure-breds don't appear to be in-pig, 'at least they're not swelling up like the fourth one', and are not cycling. The third-born bought-in large white purebred came on heat four weeks ago, was re-mated and appears to have held. The sixth 'gilt' which was 'not-in-pig' is a homebred crossbred, first litter sow that was weaned about a month ago and still hasn't come on heat.

The farmer does not have a regular 'veterinary' and no samples have been taken. The abortions occurred 'about the middle of pregnancy. There was one mummy.'

The bought-in gilts are now just over 10 months of age. One of the two home-bred, not-in-pig gilts is about the same, or maybe even 12 months old, the other about eight months old. All male pigs are marketed as entire males. The farmer probably uses his boars on one sow a week, although occasionally he may use a boar on two or even three sows in a week.

The gilts are fed grower pellets twice a day in a trough in their yard. You suggest to the farmer that the problem should be investigated further (both to determine the cause and to rule out the possibility of an imported disease being involved) and arrange to visit him next week. In the meantime, you ask him to submit his breeding herd records for the last six months. The records are summarised overall.