

Students' Perceptions of the Script Concordance Test and Its Impact on Their Learning Behavior: A Mixed Methods Study

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ABSTRACT

The Script Concordance Test (SCT) is increasingly used in postgraduate and undergraduate education as a method of summative clinical assessment. It has been shown to have high validity and reliability but there is little evidence of its use in veterinary education as assessment for learning. This study investigates some students' perceptions of the SCT and its effects on their approaches to learning. Final-year undergraduates of the School of Veterinary Medicine and Science (SVMS) at the University of Nottingham participated in a mixed-methods study after completing three formative SCT assessments. A qualitative, thematic analysis was produced from transcripts of three focus group discussions. The quantitative study was a survey based on the analyses of the qualitative study. Out of 50 students who registered for the study, 18 participated in the focus groups and 28 completed the survey. Clinical experience was regarded as the most useful source of information for answering the SCT. The students also indicated that recall of facts was perceived as useful for multiple-choice questions but least useful for the SCT. Themes identified in the qualitative study related to reliability, acceptability, educational impact, and validity of the SCT. The evidence from this study shows that the SCT has high face validity among veterinary students. They reported that it encouraged them to reflect upon their clinical experience, to participate in discussions of case material, and to adopt a deeper approach to clinical learning. These findings strongly suggest that the SCT is potentially a valuable method for assessing clinical reasoning and enhancing student learning.

Key words: formative assessment, educational impact, assessment for learning, script concordance test, clinical reasoning

INTRODUCTION

Assessment has been shown to have a major influence on students' learning behavior.¹⁻⁴ While the relationship between assessment and learning is complex, factors contributing to its educational impact include the context, format, timing, and consequences of assessments.⁵⁻⁸ The current study explored the effects of an assessment of clinical reasoning, the Script Concordance Test (SCT), on student learning behavior.

The SCT was first described by Charlin⁹ as an assessment tool designed to test clinical reasoning in authentic but ill-defined scenarios. The development and evaluation of clinical reasoning skills is an important component of veterinary education, and there is evidence that the SCT may be beneficial in this process.⁹⁻¹⁸ Several theories have been proposed to explain the cognitive processes involved in clinical reasoning and decision making.¹⁹ Script theory is one such example. It describes the way clinicians store and utilize their knowledge when faced with clinical cases. Illness scripts are modified and enriched with case exposure and increasing clinical expertise.⁹ Based on

script theory, the SCT assesses the ability of the candidate to interpret data relating to a clinical problem. A short case description is followed by a hypothesis regarding the diagnosis and further investigation or management of the patient. New information is then provided and the candidate is asked to make a judgment about the likelihood of the hypothesis based on this new information.^{10,11} An example SCT question is provided in Figure 1. In contrast to many other multiple-choice question (MCQ) formats there is no single best answer. A candidate's responses are compared to those of a panel of experts, and points are awarded for the degree of concordance between the candidate's response and the view of the expert panel.¹²

Several studies describe the implementation of the SCT in postgraduate¹³⁻¹⁶ and undergraduate assessment.^{12,14,17,18} Although few studies exist in a veterinary context, Ramaekers et al.¹² describe the development of the SCT for undergraduate veterinary students. Reliability studies have shown the SCT method to have acceptable alpha values when a panel size of at least 10-15 experts is used,^{13,15,20,21} and there is evidence to support the validity

I. Clinical Vignette

You are presented with an 8 month old, male, neutered DSH cat with a history of diarrhoea for 4 months. The cat is well in himself, his appetite is good and he is gaining weight at an appropriate rate for his age. There is no history of vomiting, the diarrhoea contains mucous and the owner sometimes observes the cat straining. The owner is pregnant and clearly concerned about her ability to cope with the cat long term if the condition is not resolved, she tells you he often leaves large wet patches of faeces where he has been and she is fed up with having to continually disinfect her house. The cat has access to the outside throughout the day and there are no other cats in the house.

Hypothesis

Suppose the diagnosis you consider is *Giardiasis*

New Information

And you discover that the cat was non-responsive to 2 previously prescribed courses of metronidazole

Then this hypothesis is:

- very unlikely
- unlikely
- neither likely nor unlikely
- more likely
- very likely

(1 mark)

Figure 1: The layout of the SCT question as seen by the students in the SCT online assessment

of the SCT as an assessment of clinical reasoning.^{13–16,22} Hornos et al.²³ describe the use of the SCT format to provide online continuing professional development to physicians to promote reflective practice. Larsen²⁴ advocates the exploration of SCT as a learning tool. Despite the above research, there is, to date, a gap in the literature regarding students' perception of the SCT and its impact on their approaches to learning. Furthermore, few studies support the use of the SCT within veterinary education. This study uses the concept of "assessment for learning"²⁵ and aims to answer two questions:

1. What are veterinary students' perceptions of the SCT?
2. To what extent does the SCT influence learning behavior in veterinary students?

METHODS

A mixed-methods approach was used in this study, namely student focus groups and an online questionnaire. The participants of this study were students from the School of Veterinary Medicine and Science (SVMS) at the University of Nottingham. For students at SVMS, the final year consists of clinical practice rotations during which they are assessed on their practical skills. At the end of their final year, students have the opportunity to complete a formative assessment before they sit a compulsory summative examination, including an SCT paper that constitutes 25% of the total examination mark. An email was sent to all final-year students inviting them to participate in the study. Volunteers were sent a link to three online SCT papers, which they were able to access on or off campus in their own time with access to online and textbook resources. They were informed that the assessments were formative and that the results would remain anonymous and would not contribute to their

final-year degree mark. The study was approved by the SVMS ethical review panel and conducted in accordance with the guidance outlined in the *Revised Ethical Guidelines for Educational Research* (2011).²⁶

Each assessment contained between 20 and 24 questions and was delivered through the University of Nottingham's online assessment system, ROGO (Figure 1). On completion of the test, the students were directed to a feedback screen where the responses from the panel could be seen along with the student score for each question. In addition to the quantitative responses, feedback was provided in the form of qualitative comments from the panel collected during the development of the SCT. Figure 2 provides an example of the information received on the feedback screen.

After completing the assessments, students were invited to attend a focus group and complete an online questionnaire. Each focus group lasted around 30 minutes. The discussions were recorded using a digital voice recorder, and the recordings were transcribed verbatim. The online questionnaire was informed by the focus group data, and a pilot study with final-year students resulted in minor modifications to the final version, shown in Table 1. The students were asked to rate the SCT in comparison to other assessment formats they had been exposed to in either year 4 or 5 of the course. An overview of these formats is provided in Table 2.

The quantitative data from the survey were analyzed in IBM SPSS version 19. Likert-type responses were converted to a numerical scale, and Friedman's ANOVA was used to compare ratings for different resources used by students and different exam formats.²⁷

The qualitative data from the focus groups were analyzed using thematic analysis.²⁸ Initial codes were identified using an inductive approach and subsequently

Key:

√ Correct answer

× Incorrect answer

Emboldened words represent the correct response for each question (not the user's answer).*Feedback is displayed in dark red italics***I. Clinical Vignette**

You are presented with an 8 month old, male, neutered DSH cat with a history of diarrhoea for 4 months. The cat is well in himself, his appetite is good and he is gaining weight at an appropriate rate for his age. There is no history of vomiting, the diarrhoea contains mucous and the owner sometimes observes the cat straining. The owner is pregnant and clearly concerned about her ability to cope with the cat long term if the condition is not resolved, she tells you he often leaves large wet patches of faeces where he has been and she is fed up with having to continually disinfect her house. The cat has access to the outside throughout the day and there are no other cats in the house.

HypothesisSuppose the diagnosis you consider is *Giardiasis***New Information**

And you discover that the cat was non-responsive to 2 previously prescribed courses of metronidazole

Then this hypothesis is:

Experts

- 1 of 14 very unlikely
Metronidazole is considered to be an effective treatment for giardia in cats
- 8 of 14 **unlikely**
should have responded to metronidazole but would depend on the dose and duration of treatment
- 5 of 14 neither likely nor unlikely
Would want to be sure of owner compliance. Can get resistance and some therefore use fenbendazole as first line treatment
- more likely
- very likely

unanswered

0 out of 1

Figure 2: The feedback screen as seen by the students on completion of the formative SCT assessment

organized into broader themes that describe the salient features of the data. Collaborative coding of one transcript enabled initial codes to be refined in an iterative process until the coding structure was agreed on by the researchers (see note on contributors at the end of this article). This coding was then used by the primary researcher to analyze the remainder of the transcripts.

RESULTS

Out of a cohort of 90 students, 50 students registered for the study. Of those, 35 students (70%) completed the assessments, 18 students (36%) participated in the focus groups, and 28 students (56%) completed the survey.

The Survey

Clinical experience was considered the most useful source of information when answering the SCT (Friedman ANOVA $\chi^2 = 48.7, p < .001$), as shown in Table 3. Students reported that they used their knowledge in

different ways when completing different assessment formats (Friedman ANOVA $\chi^2 = 49.1, p < .001$). They reported that MCQs require mainly recall of information, whereas the SCT, Direct Observation of Procedural Skills (DOPS), and clinical reasoning examination formats require students to apply their knowledge (Figure 3a).

Although not statistically significant, the SCT format was most likely to promote discussion of cases (Figure 3b); students felt the DOPS was most likely to influence their workplace-based learning (Figure 3c) and encourage them to read around cases (Figure 3d). The MCQs were least likely to promote discussion, encourage further reading, or affect workplace-based learning.

The Focus Groups

A summary of the themes that emerged from the analysis is presented in Figure 4. Examples from each theme are illustrated with quotations referred to as Q1, Q2, and so

Table 1: Questions from the SCT survey reported in this study (space was provided for additional free text comments after each question)

1. How useful do you find the following sources of information when answering the SCT?						
Not at all useful		Of little use		Somewhat useful		Very useful
Lecture notes						
Textbooks						
Internet search						
Clinical experience						
2. When answering exam questions, you may rely on remembering facts that you have learnt, alternatively you may need to think and apply your knowledge to answer a question. For each of the following exam formats, rate on a scale of 1–6 which method you rely on where 1 = pure factual recall and 6 = maximum use and application of knowledge, including interpretation of information and synthesizing new ideas.						
Only recall of information		Majority recall	More recall than use of knowledge	More use of knowledge than recall	Majority use of knowledge	Maximum use of knowledge
MCQs						
Clinical reasoning						
DOPS						
SCT						
3. How often do you discuss different exam questions? For each of the following question types state how often you would discuss them on a scale of 1–6, where 1 = never and 6 = always promotes discussion with vets and other students.						
Never discuss		Occasionally discuss	Sometimes discuss	Often discuss	Frequently discuss	Always promotes discussion
MCQs						
Clinical reasoning						
DOPS						
SCT						
4. Do different exam questions alter your approach to clinical placements? For each of the following question types state the extent to which your approach would be influenced on a scale of 1–6, where 1 = no influence and 6 = greatly influences your approach to clinical placements.						
Would not influence my approach		Negligible influence	Small influence	Moderate influence	Considerable influence	Greatly influences my approach
MCQs						
Clinical reasoning						
DOPS						
SCT						
5. To what extent do exam questions encourage you to read around a case or topic? For each of the following question types state how often you read around the subject on a scale of 1–6, where 1 = never and 6 = always read up on the case or topic in the question.						
Never		Occasionally	Sometimes	Often	Most of the time	Always read around the subject
MCQs						
Clinical reasoning						
DOPS						
SCT						

Table 2: Assessment formats used for comparison to the SCT in the survey

Assessment format	Description
MCQ	Delivered in all 5 years of the course, completed online, and consisting of A- and R-type questions
DOPS	Workplace based assessment of clinical skills, completed during clinical placements in year 5
Clinical Reasoning exam	Delivered in year 4, a case-based, short-answer paper in which students are required to write free-text responses

Table 3: Student responses to the question “How useful do you find the following sources of information when answering the SCT?”

Source of Information	VU	SU	OLU	NU
Clinical experience	21	7	0	0
Lecture notes	5	16	6	1
Internet search	2	11	14	1
Textbooks	0	19	8	1

VU = very useful; SU = somewhat useful; OLU = of little use; NU = not at all useful

on. Focus groups are identified by the order in which they occurred.

Educational Impact

A theme that clearly emerged from the data was the educational impact of the SCT and, in particular, its influence on the learning behavior of the students. There was evidence of a deep approach to learning in response to the SCT assessments. In Q1, the student describes thinking in more depth about a case and linking the questions to previous experience:

Q1: *“Often with the MCQs I would try and picture like a lecture slide I’ve seen or something I’ve written in my notes. Whereas with this one (SCT) I try and think back to like if I was to see this case, what would I do? I try and think through it step-by-step, whereas I just try and search for that one slide in my head when it’s an MCQ.”* FG4

Q2 illustrates how the feedback provided by the expert panel encouraged case discussion:

Q2: *“Well I find that normally it just tells you the answer and you just accept that yes I got it wrong. Whilst these ones (SCT) kind of provoked more discussion because there were different opinions.”* FG2

The data indicated that workplace-based learning (WPBL) is considered essential to success in the SCT and in Q3 the student describes how the SCT encouraged a more enquiry-based approach:

Q3: *“I find myself asking like why would you do this instead of that a bit more. So why did you choose to do an x-ray instead of an ultrasound in this case? Because then you know that’s kind of the reasoning you need to have when you do this exam.”* FG6

Within the focus group discussion, many students commented on the immediate impact of the SCT. They found the way in which the SCT is marked reassuring and resulted in less pressure to select the one correct answer:

Q4: *“From a student perspective that makes it a bit less daunting because it’s not one answer in five that you’ve got to get or one answer in four that you’ve got to get. There’s a couple of options there.”* FG6

Validity

Discussion often included the process of decision making in practice and how this related to the SCT, therefore the validity of the SCT as a test of clinical reasoning emerged as a theme. For example,

Q5: *“The MCQs, the normal online ones, don’t seem to assess how you’d act as a vet, whereas these seemed to be a lot more comparable to sort of everyday clinical decision making.”* FG5

Some evidence for the validity of the SCT is provided by the reliance on clinical experience to answer the questions (Q1). Many students talked about higher-order learning objectives being tested during the SCT. Processes such as analysis of information and application of knowledge are important in clinical reasoning and are illustrated in the following quotation:

Q6: *“It feels like you apply your knowledge more with a script concordance test rather than just like a normal MCQ for me.”* FG6

However, several participants challenged the construct validity of the SCT when the hypothesis to consider had not been generated from their own thought process:

Q7: *“I sometimes didn’t really know where to go with the information. If I thought there was an infected joint, I think there was talk about using ultrasonography and I don’t think I’d have had that up there at all. So then I didn’t really know whether it was more likely or whether it was more unlikely.”* FG4

Acceptability

The majority of participants found the SCT an acceptable format because of its high face validity. The students considered the SCT to be a better assessment of their abilities as a vet and more relevant to decision making in clinical practice, particularly in comparison to the MCQs they had experienced so far in the course (Q5).

However, there is evidence to suggest that the SCT format can be confusing for the students, perhaps due to the order of the questions not representing the clinical reasoning process in practice:

Q8: *“And it’s difficult because it seems to ask you to sort of disregard the information in the previous question and then have a new one, which is hard because it’s not how case progression works in any way in your mind.”* FG2

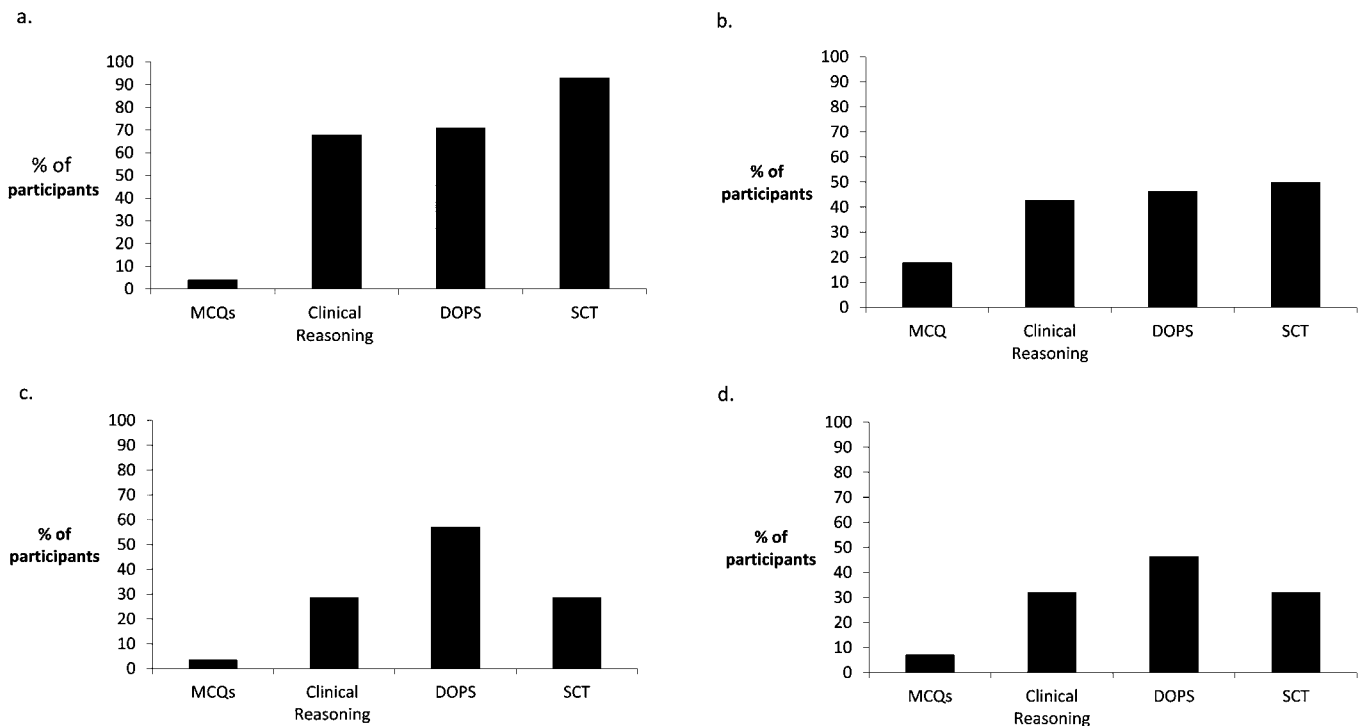


Figure 3: The impact of assessment on student learning behavior: (a) the percentage of students who stated that the format required them to apply their knowledge rather than rely on recall of factual information; (b) the percentage of students who stated the format always or frequently promotes discussion; (c) the percentage of students who considered the format to have a great or considerable influence over their approach to clinical placements; (d) the percentage of students who stated the format always or frequently encouraged them to read around a case

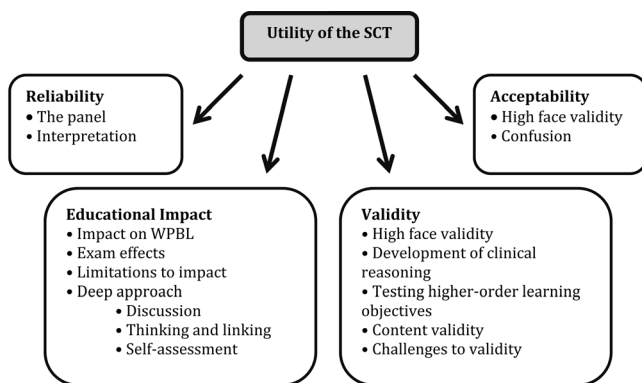


Figure 4: A summary of the themes identified in the thematic analysis of the focus group data

Reliability

A significant concern for many participants was the reference panel; several students raised concerns over the experts' interpretation of the question and the spread of panel responses. In this final quotation, the student describes favoring the options that were most likely selected by the panel:

Q9: "I think I tended to stay in the middle sort of three categories, but I think that was just me being safe and not wanting to commit. There were quite a few where if you just put the middle one, you'd get like half a mark because if it was like a little bit ambiguous." FG2

DISCUSSION

The students' perceptions of the SCT encouraged them to reflect and draw upon their clinical experience when responding to SCT questions. The addition of the feedback screen with comments provided by the expert panel added to the learning experience by promoting discussion and, to some extent, further reading. For some students, the impact extended to their WPBL, where the SCT encouraged a deeper approach to cases and discussion with peers and supervising clinicians.

This study adds to the sparse published evidence on students' perception of the SCT and its impact on their approaches to learning.²³ The SCT in this study had high face validity and consequential validity. It provides evidence to support the use of the SCT as a learning tool,²⁴ and it fits within the broad domain of methods of assessment for learning (as opposed to assessment of learning).^{25,29} The SCT is yet another example of how the perception of a mode of assessment can influence approaches to learning.^{2,5,8,30,31}

Not all students had an entirely positive view of the SCT. Some considered the concept of reasoning around limited case information to be confusing and inconsistent with the clinical reasoning process in practice, thus supporting the concerns raised by Askew et al.³² Clinical decision making in conditions of uncertainty is a requirement for new graduate veterinary surgeons. While exposure to patients is essential to develop these skills, it is insufficient on its own.¹⁹ The perceived benefits of the SCT by many students support the development of this formative assessment to facilitate the development of clinical reasoning within veterinary curricula. With increasing student numbers, universities are faced with challenges to maintain effective delivery of WPBL. The SCT provides effective trigger material for case discussions and feedback to students from clinicians. It should therefore be considered as a method to enhance clinical teaching.

However, this study is based on a sample from one cohort of students from one veterinary school within the UK. Participation in the survey and focus groups was voluntary, and, as such, it is important to acknowledge that the participants may not be representative of the entire student population and may demonstrate a different approach to their learning and clinical development. These findings should therefore be treated with some caution until the research findings are confirmed in other contexts. Lineberry et al.³³ recently challenged the validity of the SCT, concluding that the traditional method of aggregate scoring and variation in responses from the expert panel are significant flaws in the SCT format. Although the current study was not concerned with the psychometric properties of the test, some participants in the focus groups identified concerns regarding the consistency of the panel.

In conclusion, this study has shown that the SCT was perceived by students as a useful assessment tool that prompted them to reflect upon and apply their clinical knowledge and subsequently to discuss and deepen their approaches to clinical problems. These findings strongly suggest that the SCT is potentially a valuable method of assessment of clinical reasoning and can also provide assessment for learning in clinical veterinary education.

CONTRIBUTORS

KC contributed to the design of the study, collected and analyzed the data, and contributed to drafting the article for publication. LM contributed to the design of the study, the collaborative coding of the qualitative data, and the draft for publication. GB contributed to the design of the study and the draft for publication. RH contributed to the design of the study, and all authors approved the final manuscript for publication.

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DECLARATION OF INTEREST

The authors report no declarations of interest. The authors alone are responsible for the content and writing of this article.

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