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Langebaek, Rikke; Tanggaard, Lene ; Berendt, Mette

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Veterinary Students' Recollection Methods for Surgical Procedures: A Qualitative Study

Rikke Langebæk ■ Lene Tanggaard ■ Mette Berendt

ABSTRACT

When veterinary students face their first live animal surgeries, their level of anxiety is generally high and this can affect their ability to recall the procedure they are about to undertake. Multimodal teaching methods have previously been shown to enhance learning and facilitate recall; however, student preferences for recollection methods when translating theory into practice have not been documented. The aim of this study was to investigate veterinary students' experience with recollection of a surgical procedure they were about to perform after using multiple methods for preparation. From a group of 171 veterinary students enrolled in a basic surgery course, 26 students were randomly selected to participate in semi-structured interviews. Results showed that 58% of the students used a visual, dynamic method of recollection, mentally visualizing the video they had watched as part of their multimodal preparation. A mental recipe was used by 15%, whereas 12% mentally visualized their own notes. The study provides new information regarding veterinary students' methods of recollection of surgical procedures and indicates that in Danish veterinary students a visual dynamic method is the most commonly used. This is relevant information in the current educational situation, which uses an array of educational tools, and it stresses the importance of supporting the traditional surgical teaching methods with high-quality instructional videos.

Key words: surgical education, instructional video, multimodality, learning and memory, mental visualization

BACKGROUND

Within recent years, views on learning and education have changed dramatically. Pedagogical research has demonstrated that the traditional perception of learning as the transfer of information from teacher to student is no longer appropriate. The general understanding is that learning takes place when students actively build their own knowledge structures based on prior knowledge and experience.[1–3] In recent years, alternative teaching methods have been introduced into veterinary surgical education, both due to the pedagogical research and for ethical, practical, and economic reasons.[4,5] The development of computer-aided learning, online teaching, and skills labs with models has accelerated accordingly,[6] and a multimodal teaching method—a blend of visual, auditory, reading/writing, and kinesthetic activities—is increasingly used in veterinary surgical education. In pedagogical research, multimodality is recommended to support memory, learning, and interest. The array of formats and experiences thus provides students with a variety of material for building the new knowledge structures.[7–10]

When veterinary students face their first live animal surgical procedure, their level of anxiety is generally high[11] and this can affect their ability to recall what has previously been integrated, for example with respect to how to perform the intended surgical procedure.[12,13] Using educational methods that engage more than one part of the brain has been shown to enhance learning and facilitate recall, and multimodal teaching methods may therefore be a way to facilitate memory in stressful situations like this.[2,14,15] Furthermore, it has been demonstrated that providing students with visual as well as verbal teaching material enhances learning and recall regardless of students' cognitive preference.[16–18] In an extensive review on learning styles, Coffield concluded that students should in fact be encouraged to use unfamiliar styles, thereby recruiting more parts of the brain, and not just the usual, preferred parts.[14] On the other hand, educational subjects should still be presented in a format that makes sense and matches the subject (e.g., presenting a dog breed with an illustration generally makes more sense than presenting it as a text).[19–21] Surgical education comprises cognitive as well as technical, hands-on elements,[6,22,23] and is well suited for multiple modes of representation. Therefore, we have at the Department of Veterinary Clinical and Animal Sciences (University of Copenhagen) introduced surgical teaching methods and preparation for live animal surgery that include a line of educational tools: online teaching (narrated PowerPoint presentations and videos), textbook reading, lectures, and training on low-fidelity models and cadavers. This prepares students for live animal surgery on research

pigs and finally supervised surgery on live patients. Although several studies have investigated the effect of individual educational tools on students' performance of live animal surgery, no studies have investigated student preferences for recollection methods when translating theory into practice. The aim of the present study was to investigate veterinary students' experience with recollection of a surgical procedure they were about to perform after having access to multiple preparation methods.

MATERIALS AND METHODS

Study Design

The investigation was conducted as a qualitative study, although it also used quantitative methods to support some parts of the analyses performed. The study was performed in the fall of 2009 during a Basic Surgical Skills (BSS) course at the Companion Animal Teaching Hospital, Department of Veterinary Clinical and Animal Sciences, Faculty of Health and Medical Sciences, University of Copenhagen. Semi-structured interviews were conducted to collect data.

Setting

The BSS course takes place in the first semester of the fourth year of the veterinary curriculum. It comprises an 8-day practical course including 4 days of surgery in a terminal pig lab approved by the Ethical/Administrative Board at DVCAS, University of Copenhagen (gastrotomy, enterotomy, cystotomy, intestinal resection and anastomosis, tracheostomy, orchiectomy).

Two senior veterinarians are in charge of teaching, supervising, and evaluating students. The course is held five times during this semester with 32–36 students attending each single course.

Students' preparation for the live animal surgical procedures in the pig lab consists of the following:

- textbook reading of chapters in *Small Animal Surgery*[24] related to basic surgical skills as well as descriptions of the specific surgical procedures described above;
- a 2-hour lecture presenting the specific surgical procedures and the practical information regarding the pig lab sessions;
- online material: narrated PowerPoint presentations (describing basic surgical and surgery-related skills and accompanying theory) and videos demonstrating the specific surgical procedures;
- two days of basic surgical and surgery-related skills practice in a Skills Lab with toy animal models (suturing techniques, hemostasis, ligating techniques, incision techniques, preparation of surgical field and surgeon, injection techniques); and
- two days of practice on cadavers donated to the hospital (skin suturing techniques).

Participants

The study population consisted of 171 veterinary students in their fourth year and enrolled in the BSS course in 2009. From this study population, 26 students were randomly selected to represent the study group and invited to participate in an educational research project by giving individual semi-structured interviews. All students gave written informed consent to participate in the study in which confidentiality and anonymity were ensured. The study was approved by the Ethical/Administrative Board at DVCAS, University of Copenhagen.

Semi-Structured Interviews

To collect information about students' learning experiences in relation to their first live animal surgical procedures, individual semi-structured interviews were conducted using Giorgi's empirical phenomenological methodology. By describing explicit methods for collecting and analyzing data through interviews, Giorgi's methodology strives to make human life–world experiences the subject of science[25]:

1. Subjects describe.
2. During the interview, the interviewer condenses and interprets the description, and then has the interpretation confirmed or corrected by subjects.
3. The recorded interview is transcribed.
4. The transcribed interview is analyzed by the interviewer/researcher.
5. Analysis is validated by discussions with independent researchers and/or randomly selected subjects.

Interviews were conducted immediately after each student's first day of live animal surgery in the pig lab. Interviews were performed by the first author (RL), lasted 20–30 minutes, and were audio recorded and subsequently transcribed verbatim. To provide a consistent structure across the data set, an interview guide was developed based on research questions addressing the surgical learning situation, and the students were allowed to spontaneously report what they experienced. The interview guide consisted of four main questions regarding students' experience with the surgical learning situation in general ("Tell me about your experiences in the Surgical Skills Lab"; "Tell me about your experiences with live animal surgery on the pig"; "Describe to me what you gained from working with the models, if anything"; "Tell me about your experiences with the atmosphere in the learning environment") and several detailed questions, one of these being, "While standing at the operating table and about to perform surgery, how do you recall how to perform the procedure?"

During the interview, the interviewer condensed and interpreted what the students described, and subsequently had the interpretation confirmed (validated) by "returning" it to the interviewee: "So, if I understand this correctly you recall by.... Please correct me if I'm wrong." The students thus had the opportunity to correct the interpretation: "No, that was not quite what I meant. It was more like...."

The recorded and transcribed interviews were analyzed by the interviewer using inductive thematic analysis.[26] The interviews were read carefully to identify quotes relevant to the aim of the study. Units of text were then coded and categorized and subsequently sorted into potential themes.

Table 1: Distribution of methods of recollection, including division into subthemes ($n = 26$)

Method of recollection		Initial reply	Second choice*
Main theme	Subtheme	Count	Count
Auditory	Discussion with peers	1 (3.8%)	1 (3.8%)
Narration (lecture/online)	0	1 (3.8%)	
Visual	Static (illustrations)	0	2 (7.7%)
Dynamic (videos)	15 (57.7%)	2 (7.7%)	
Static/involved (own notes on slides)	3 (11.5%)	0	
Kinesthetic	Models/simulators	0	2 (7.7%)
Mental	Imagery	1 (3.8%)	0
Recipe	4 (15.4%)	2 (7.7%)	
Combination		2 (7.7%)	1 (3.8%)

* Eleven students mentioned a second choice.

To validate interview analysis codes and themes, these were discussed with an independent researcher (MB) as well as with five randomly selected interviewees. For the aim of this study, the analysis focused on methods of recollection of the surgical procedures. The number of participants mentioning individual themes was determined to illustrate the range of student responses.

RESULTS

In what follows, verbatim quotes are given to illustrate, clarify, and confirm results. In relation to each quote, a code suffix is used to identify participants and refers to the student's group number and initials.

During interviews, participants were asked to describe how they recalled or remembered the surgical procedures while standing at the operating table, about to perform surgery.

Seventeen participants spontaneously answered the question, a typical response being: "Well, I had seen the video, so I recalled what they did in the video" (3Su). Others needed further elaboration of the question, such as: "See if you can explain what happens in your mind when you try to remember the procedure?"

To investigate students' experience with recollection of a surgical procedure, results from the interviews were coded and divided into themes and sub-themes related to recollection and memory.

The main themes identified were as follows: auditory, visual, kinesthetic, and mental. Eleven students initially mentioned one dominating method, but later added a second choice. Within the group of 26 students, the range of responses was determined and is illustrated in Table 1.

Auditory

The auditory methods of recollection refer to methods in which students remember spoken words related to the surgical procedure. Two types of auditory methods were identified: Discussion with Peers and Narration (the narration associated with the lecture/online teaching material).

Discussion with Peers

Two students mentioned that they remembered the surgical procedure by talking it through with their peers just before undertaking surgery.

> My friend and I, we talked ourselves through the whole operation before we started. (1Su)

> Just before going into the abdomen we discussed, like: "okay, now … now I'll cut from here to there, and then you do … you make some blunt dissection. And then you get to there." So we sort of talked ourselves through the entire procedure. Even though, of course, we had watched the videos a couple of times by now, but you actually tend to forget what you've seen. So it was really nice to talk it through, and to say: now I'll do this and this. (4Th)

Narration

One student mentioned using the narration from the videos as part of recollecting:

> 3Li: [I recollect] what I've seen and heard.
>
> Interviewer: So, what exactly do you recollect? Can you elaborate?
>
> 3Li: The videos. And what the teachers have said. But then, the videos are narrated, so it's just as much the voice that I recall.

No students referred to information given during the two-hour lecture.

Visual

Participants described different visual methods of recollection. The image they visualized could be either dynamic or static.

Dynamic

The visual dynamic method refers to a method in which students recall the dynamic pictures seen in the instruc-

tional videos. This method of recollection was used by the majority of participating students (57.7%), and several students specifically described "seeing the video with their mind's eye."

> Well, I recall the video that I've watched the night before. I think it's a great way to prepare. Because I just "see" the pictures inside my head when I … so I try to recall how it was. And it kind of sticks with me better than if I had read it. (2Mo)

> Yes. I liked the video, because they get into your head somehow, so that you "see" them in front of you in a way—what they did [in the video] and what you have to do then. (3An)

Others were less descriptive and simply said that they had watched the video, and what they had seen was what they remembered.

> Well, one remembers what they did in the video. (2Na)

> Well, I had seen the video, so I recalled what they did in the video. (3Su)

Static

In contrast to the dynamic method, in which students recall moving pictures, the static method refers to recollection of a static image, for instance from a book.

> 4Ma: I recall images.
>
> Interviewer: What images?
>
> 4Ma: The ones from the book and from the slides. Not so much, actually, the ones from the video.

The static images that were recalled were sometimes combined with an active involvement from the student. These students described recalling their own notes on the paper or slide.

> I saw the procedure on video, and then I made some notes in order to remember it. So I actually think I recall my piece of paper. And I can visualize the notes that I've written down. (2Ka)

> I actually think that often, I think … I think that I remember primarily in images, because I sort of recall those slides, and then I remember that I had written something there [on the printed slide]. So, that was … well, so I probably recall images. (5El)

Kinesthetic

Two participants described recalling what they had practiced on the model in the skills lab, and used this in combination with other methods.

> [I visualize the online video in my head] … you can't see how they make the knots, but you can see what it looks like, and then you know from the toy animal models how to tie the knots, and then you put things together into something useful. (1Al)

> We have to recall different pieces of [information] from when you worked with the toy animal model or when it was presented in the lecture. Or those slides and the video. (1Pe)

Mental

Five participants did not just recollect the given information, but described how they created their own new schemes or pictures in their mind.

Mental Imagery

One student described how he/she created a mental image of him/herself performing the procedure:

> … and then you watch the video. And then you try to transfer that to your own thoughts and kind of imagine yourself doing those things. That way it becomes easier, when you're standing there with your animal and then to say: okay, now I just have to … I just have to see myself perform it totally perfectly! (5Sa)

Recipe

Four students created a mental script or recipe, a process that some of them described as "logical step-by-step thinking."

> It's … I think like this: what's the logical thing to do? You see, quite logically, if you want to reach the testicle, you have to incise the skin and subcutis first (laughing), right? … and then you'll reach some (laughing) layers in there … so … I don't think precisely … I'm not the kind of person who writes everything down. (4La)

> I suppose I think about anatomy a lot. This is how I think: "What have I reached now, and what is the next step?" Like: "This is the first layer and the next one," when you … [dissect]. I think about what seems most logical. And … I think that I simply try to recall the anatomy. (4Ju)

General Findings

Eleven participants had one initial "first choice," but added a second method or more when elaborating. Some answered that a combination of methods allowed them to recollect the surgical procedure, and two participants described that different methods best suited different parts of the procedure:

> It depends. If it's a question of which suture to choose, then I visualize the notes I wrote. And if it's more like remembering to place some extra drapes or something like that, then I visualize how it was done in the video. It just depends. (2Ka)

> I recall the video, but I also recall the illustrations from the book, because there are things that they, like … when I think about where to place the incision, I recall the book. But the rest, like with the sponges and the extra draping and those kinds of things, then I recall the video. (4Ce)

DISCUSSION

Recollection of information from (long-term) memory is a process that takes place every day throughout our lives. However, we are rarely conscious of *how* we recall information when we need it. In the present study we investigated how veterinary students recall how to perform a surgical procedure. We hoped to detect factors that can optimize surgical learning material and instructional support. We found that all participants were able to describe their experience with recollection of the procedure, even though some needed either extra time to reflect or some elaboration of interview questions. The majority of participants used the dynamic visual method for recollection and described how they mentally visualized the instructional video. This mental copying of the video is not surprizing, as the current generation is very familiar with using video material in and outside the educational setting.[8] Watching videos is part of their "prior knowledge" and experience, and is therefore a familiar cue for recollecting information. It has been shown that deliberate training in mental imagery can improve surgical performance and confidence.[27,28] If veterinary students find it useful and easy to mentally visualize the video, educators should encourage them to go a step further and imagine *themselves* performing the surgical procedure instead of the surgeon on the video.

The fact that students found the videos useful for recollection may furthermore be explained by the familiarity with and interest in this form of representation.[29] It has been documented that visual representations are processed along the same pathways as direct experience, while written and oral forms must first be cognitively processed in the brain.[6] The ease with which students recollect visual information will consequently result in a lower cognitive load.[23,30,31] One student expressed it this way:

> If you've seen the video, you know what to do. And then you have so much more [mental] energy. But it's also because it's so much easier to sit down and pull yourself together and watch a video lasting 10 minutes, for some reason, than sitting down reading ten pages—even if it takes the same amount of time. Or maybe five pages … (2Na)

Several students mentioned more than one method of recollection, and some spontaneously expressed the usefulness of combining different methods, thereby showing that they used a multimodal method. Interestingly, some students were able to express which methods were best suited for specific parts of the procedure. This reflects the findings that instructional methods should suit the subject and that different representations should be available to give students the possibility to use more than one part of the brain.[9,10,14] Only two participants mentioned the kinaesthetic method—recalling what they had felt when training with their hands. This is probably because part of motor learning is subconscious[22]—often referred to as "muscle memory," but can also be explained by the fact that the models in our skills lab represent basic surgical skills and not entire surgical procedures. Only distinctive subtasks were trained on models, and recalled as such by students. A similar situation exists for our cadaver lab, in which students train skin suturing techniques but not larger surgical procedures.

Finally, there was no mention of recollecting information given by the traditional teaching methods: verbal (textbook) or auditory (from the lecture). However, some students used their own notes, part of which had been taken during the lecture or while reading the literature.

A weakness of our study is that it can only describe what students are conscious of. Obviously it is not possible to clarify what goes on at the unconscious level. It must be noted that we investigated students' perceptions of the situation in which they had to use information from their long-term memory. We did not investigate the level at which learning took place, and could therefore only conclude that students all reached the low level in Bloom's taxonomy: recall/copy/reproduce.[32] However, the aim of this study was not to compare levels of learning, but to investigate students' methods of recollection and to present the range of their responses to illustrate this.

A semi-structured interview format was chosen in this study and allowed for in-depth exploration of students' experiences with recollection of surgical procedures. By using a qualitative research method and by interviewing several participants, it is possible to identify commonalities. This requires that the sample be sufficiently large, which seems to be the case in the current study as we reached saturation of emergent themes during interviews. The qualitative, interview-based research method does not provide us with statistical evidence representing the entire population, which may be a limitation of the study. However, quantification of the results allowed us to highlight certain patterns.

Finally, there is a risk that the interviewer (who was in some instances also the course teacher) may have influenced student responses. However the research questions in the present study addressed the students perception of their own method of recollection, and therefore had no direct relation to the actual teaching situation, performance, or any teacher evaluation of skills. Although a bias cannot be excluded, the risk is considered low.

The present study provides new information regarding recollection of a surgical procedure and indicates that a visual dynamic method for recollection is probably the most commonly used by veterinary students. Our results certainly stress the importance of high quality videos as an integrated part of multimodal teaching methods. However, if students simply copy and recall the videos, they will reach only the lowest level of learning in Bloom's taxonomy.[32] Our study did, however, document that some students are able to consciously create their own methods of recollection through mental imagery and logical thinking and thus can bring themselves to a higher level of learning (Bloom's taxonomy).[32] Consequently, it is essential that veterinary educators be aware that such abilities exist in students, and actively engage in developing learning environments that can help students to activate the reflective and creative processes involved in higher levels of learning.

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AUTHOR INFORMATION

Rikke Langebæk, DVM, PdD, is Assistant Professor in the Department of Veterinary Clinical and Animal Sciences, Faculty of Health Sciences, University of Copenhagen, Denmark. Email: ril@sund.ku.dk. Her main areas of interest are surgical training and developing and implementing innovative ways of teaching veterinary students.

Lene Tanggaard, Cand.Psych, PhD, is Professor at the Center for Qualitative Studies, Aalborg University, Kroghstræde 3, 9220 Aalborg Ø, Denmark. Her main areas of interest are qualitative research, creativity, and communication.

Mette Berendt, DVM, PhD, is Professor in the Department of Veterinary Clinical and Animal Sciences, Faculty of Health Sciences, University of Copenhagen, Denmark. Her main areas of interest are veterinary neurology and clinical teaching of veterinary medicine.