Effective Studying for Trainees

An ANZCA Education Module

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This is a self help educational module designed to assist Trainees (and others) who wish to know more about effective studying or improve their own study techniques. Although there are many methods of study, those described below have proven to be effective for a wide range of students studying a wide range of topics. They have consistently been found to be successful for Trainees preparing for either the Primary or Final Examination. It should be noted that this article is the opinion of the authors and does not constitute a formal recommendation by the College.

Aim
The aim of this module is provide the Trainee with proven effective study skills.

Objectives
Completion of this module will assist Trainees:
- Acquire a positive attitude to study.
- Implement an effective study regimen.
- Practice effective revision techniques.
- Internalise psychological strategies for maximising learning.

Suggested Approach
Supervisors of Training (SOTs) may offer this module to Trainees 12 or more months prior to their intended sitting of a Primary or Final Examination. The module is particularly useful for Trainees who have previously been unsuccessful in sitting for an examination. Trainees should read through the module and consider the suggested study techniques. It is anticipated that many Trainees already undertake one or more of the techniques described in this module. Trainees should review their effectiveness in their implementation of these techniques in line with the suggestion provided in this module. Trainees may also try and implement those techniques that are described in the module yet not currently implemented by the Trainee.

Much of this module focuses upon the use of cards as a study tool. However, many Trainees will opt not to use cards, preferring loose leaf, exercise books or even notes on computer. The principle ideas of spaciousness, varied layout, and use of colour still apply.

The amount of knowledge to be mastered for the FANZCA examinations is substantial. Trainees often feel time-pressed when they start studying, covering a great deal of material at insufficient depth and without affording themselves adequate revision time. This article details an approach that generates material in a format that is accessible, digestible and focussed upon examination techniques.

The module also contains two practical exercises which the Trainee should undertake. The module concludes with recommended reading and a series of tips for maximising the effectiveness of your study.

Materials required
- A selection of blank cards (for example, 10 x 15 cm, 12 x 20 cm and 7 x 10 cm cards).
- A selection of coloured texta pens (for example, Crayola Overwriters).

Success in study is a combination of positive attitude, time management, an effective study program and dedication.
• A selection of highlighter pens.
• Chapter 11 from *Nunn’s Applied Respiratory Physiology*

*It is helpful to remember that what the student does is actually more important in determining what is learned than what the teacher does.*

Thomas J. Shuell

Given that anaesthetic Trainees will spend several hundreds of hours studying in their own time for exams, it is surprising that little attention is paid to how to make that time most effective. While many study efficiently, some struggle - with ineffective practice, loss of confidence, high anxiety and occasionally recurrent failure of exams. Many Trainees would benefit from reviewing their study habits.

There are a wide variety of successful approaches to study. This module does not aim to be prescriptive, but rather to outline basic concepts, make practical suggestions and stimulate discussion. It is based on a review of educational literature (see recommended reading), coupled with the experience of teaching this topic to anaesthetic Trainees and medical students.

For effective studying, significant areas include:

• note taking and making,
• revision techniques,
• assessment of progress, and
• psychological aspects.

**What to Learn?**
The course outline is a good place to start. Others who have successfully sat recently may also be a good source of references. Questions from past papers are an indication, particularly those that candidates struggled with.

**How to Learn**

**Notes**
Good notes are the foundation of effective studying. Often the first exposure to a new topic will be in a lecture or small group tutorial, and it is well worthwhile to make as good a set of notes as possible. If faced with a choice of making notes or trying to listen and understand new material, some commentators recommend obtaining good notes.

The layout of notes can be important. Good notes will be well spaced, legible and tidy. One method of lecture note taking allows for a 4 cm wide left margin for later annotations, and a similar space at the bottom of the page for summarising all the material contained on the page.

Having attended a lecture and made notes most Trainees will wish to summarise, or rewrite the material. Some students find it useful to reformat the main points of
the lecture onto cards. If the original notes are of a good quality, this may not be necessary, however cards also form an ideal revision tool.

Cards
Cards are used widely by anaesthetic Trainees and are a most effective aid to study. They offer portability, are robust, easy to write, update and replace, and are readily accessible. Cards also have the advantage of helping to divide large fields of study (such as anaesthesia) into appropriate manageable “chunks” suitable for a 10 minute essay or a brief discussion.

To make cards user-friendly it is recommended to keep them uncluttered, that is, to avoid putting too much on one card. If a card is crammed with small writing from top to bottom, one great attribute is lost - easy visual recognition. Easy visual recognition facilitates revision, memorizing and recall.

Writing too much on a card is a common fault for Trainees. It is preferable to keep the cards spacious and to use colour. For example, a range of texta type pens like Crayola “Overwriters” provide striking visual effects. Varying the layout to give each card a distinct characteristic will also make the revising and learning process easier. How many cards are needed? Some successful registrars suggest at least a shoebox full for each of the Primary and Final Examinations.

An overview or definition is often a good way to start a card and can form the basis for the other main points on the card. Think about why you put information on your cards; does it illuminate the topics or is it something the examiners will be looking for? Can you leave it off without detracting from the value of the card?

Look for structure in your cards, lots of things can be discussed in similar ways. The less you have to remember the easier it gets.

An important point is to not try to get all the relevant information about a topic on one card. Use as many cards as required - spacially laid out. The reverse side of the card can have the name of the topic - or better still a question, for example, what are the side effects of suxamethonium? (see Figure 1) If revising the card the student can attempt the question before checking the answer. This makes the learning ACTIVE, rather than passive. Active learning has consistently been shown to be more successful.

Figure 1: Example of a card (back and front).

<table>
<thead>
<tr>
<th>SUXAMETHONIUM SIDE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. muscle pains postoperatively</td>
</tr>
<tr>
<td>2. ↑ K+</td>
</tr>
<tr>
<td>3. ↑ I.C.P. ↑ I.O.P ↑ I’gastric pressure</td>
</tr>
<tr>
<td>4. suxamethonium apnoea</td>
</tr>
<tr>
<td>5. malignant hyperpyrexia</td>
</tr>
</tbody>
</table>

Keep cards uncluttered. Use colour textas and highlighters.
What size of card to use? This is a matter of personal preference. There are arguments for and against any size cards. It is up to the Trainee to experiment to determine which size card best compliments their personal preference (for example, 10 x 15 cm cards readily fit into a pocket, whereas the use of 12 x 20 cm cards more readily avoids clutter). 7 x 10 cm “flash” cards are useful to enhance rote-learning tasks, for example, M.A.C. values, formulae. Cards can be purchased in different colours for different topics. Some Trainees prefer white, as applied colour appears more vivid on a white background.

Having recorded the information, the next step is learning it.

Exercise 1
A useful chapter that Trainees may wish to revise prior to sitting for the Primary Examination is Oxygen (chapter 11) in Nunn’s Applied Respiratory Physiology.

- As an exercise look through this chapter and summarise the important points onto a series of cards (experiment with the different size cards you have available and choose the size that best suits you).
- Particular points that you should look for are those that you are likely to be asked in an exam. These may include material that is common, interesting, difficult or paradoxical. Graphs are also useful as they are economical ways of describing relationships.
- Use colour to highlight specific information as you deem appropriate for your learning style.
- Once you have completed this exercise look through the cards that are included below. These were prepared by Dr Craig Noonan, an experienced teacher and Supervisor of Training. Craig has included annotations within his cards explaining why he has chosen to incorporate some of the points he has included and why he has chosen to omit other information. It is this skill that the Trainee must seek to master and Craig’s annotations provide valuable insight into the thought processes of an experienced card user.
- Now write a 10 minute essay on each of your cards. Make sure you understand all of what you write (if you do not, then undertake more reading, ask a colleague, seek clarification from a staff member, etc).

CARD 1: Nunn: Chapter 11. Oxygen

<table>
<thead>
<tr>
<th>Chapter headings</th>
</tr>
</thead>
<tbody>
<tr>
<td>role</td>
</tr>
<tr>
<td>cascade</td>
</tr>
<tr>
<td>normal art (O_2) level = 102 - 0.3 (age in years)</td>
</tr>
<tr>
<td>carriage</td>
</tr>
<tr>
<td>transport</td>
</tr>
<tr>
<td>tissue (PO_2)</td>
</tr>
<tr>
<td>(O_2) stores and steady state</td>
</tr>
<tr>
<td>control / cyanosis / content</td>
</tr>
</tbody>
</table>
CARD 2: Role of O₂

- 90% used by cytochrome c oxidase
- Classification of oxidases (def: catalyse O₂ reduction)
  - electron transfer oxidase
    \[ O₂ \rightarrow O₂^- \text{ or } OH^- \text{ or } H₂O \]
  - oxygen transferase
    e.g. cyclo-oxygenase, lipoxygenase
  - mixed function oxidase
    e.g. cytochrome P-450

Oxidative phosphorylation (has its own card)
Cyclo-oxygenase (has its own card)
Cytochrome P450 (has its own card)

CARD 3: Oxygen cascade

- is the step down in O₂ pressure from dry air at atmospheric pressure to mitochondrial values
  - Dry air
    - value & derivation
  - Humidified air
    - value & derivation
  - Alveolar
    - value & derivation
  - Pulmonary end capillary
    - typical value, reason for difference
  - Arterial
    - typical value, reason for difference
  - Mixed venous
  - Tissue
  - Mitochondrial

CARD 4: Alveolar/arterial PO₂ difference

- can be quantified by the shunt equation
- know that this replaces the scatter of low V/Q ratios and true shunt with a theoretical venous admixture
- understand why regions of high V/Q ratio can't compensate for areas of low V/Q ratio

Factors affecting value of A-a O₂ diff:
  - actual alveolar PA O₂
    (higher tends to be associated with greater A-a differences)
  - CO: simplistically has inverse relationship and shunt accentuates any fall BUT more complex as:
    1. content vs. tension
    2. dec. CO causes dec. shunt fraction
  - temp / pH / base XS
  - Hb level
  - inc. alveolar ventilation
we know from alveolar gas equation that alveolar PaO2 will increase with inc. ventilation

hence logical that end-pulmonary capillary O2 should also increase

BUT PARADOXICALLY we see a fall in PaO2 with shunts > 5% as VA increases

WHY??
The key to understanding this is that the CO falls as VA increases (2' to decreased sympathetic tone)
This implies greater extraction of O2 from arterial blood if total O2 consumption stays the same.
So as CO falls, shunted blood will return with even lower PO2 values.
As there is a ceiling on content for non-shunted blood, the average or arterial value must be lower as CO falls, as VQ increases

CARD 5: Carriage of O2 in blood

Structure of Hb:
- 4 protein chains
- 4 haem groups
- 4 Fe+2
- 4 molecules of O2

Consider writing separate cards for Hb Synthesis and Breakdown

Capacity: 1.39 g/dl theoretical maximum c.f. 1.31 measured

Kinetics:
- progressively faster despite dec. in no. of sites (same for CO as for O2)
- dissociation slower (espec. for CO c.f. O2)

Oxy-Hb dissociation curve
- should be able to draw, understand P50
- know things that cause R-shift (inc.temp, inc. CO2, inc. 2,3DPG, dec. pH)

CARD 6: CO poisoning

binds to Hb; fast on, very slow off so "accumulates" on Hb

\[ t_{1/2(\text{air})} = \frac{4}{24} \]
\[ t_{1/2(100\%)} = 90' \]

- distorts shape of dissociation curve so less able to unload O2
- understand why 50% anaemia is survivable and 50% binding with CO is lethal

CARD 7: Stores and steady state

- can compare sites of storage of O2 breathing room air and 100% O2
- basically dismal
- Copied table from book
- decreased with circulatory arrest, apnoea, dec. barometric pressure, inhalation of N2 or N2O

That is all Craig wrote. Some other thing you may argue he should also have included, but he might put them elsewhere, e.g. foetal Hb goes in Foetal/ Maternal Physiology. Some things Craig chose not to note down because he already knew
them thoroughly and will "never" forget them. Some things he decided he was not going to learn e.g. O₂ delivery and consumption. Some things he approaches differently, e.g. cellular hypoxia. His definition is a failure of the cell to utilise O₂ which can be anoxic/stagnant/anaemic (i.e. supply) OR histotoxic e.g. cyanide, salicylates (i.e. utilisation).

Your cards are there to be a resource that works for you. This example is meant to highlight an approach that might help you organise your study. These cards work for Craig, but you must write cards that work for you. Experiment with your cards until you develop a technique that is best for you.

Revision
The work of Ebbinghaus is a good place to begin considering revision. Ebbinghaus was a 19th Century German psychologist who studied memory and is famous for his forgetting curve (see Figure 2). This work has been reproduced in a variety of contexts. Most of us would believe it to be true from our own experience.

Figure 2: Ebbinghaus “Forgetting” Curve.

Humans rapidly begin to forget.

Reviewing material facilitates long term memory.

What can we do to counter this natural tendency of the brain to forget? The answer lies in reviewing material a number of times within a short time of first studying it (see Figure 3).
Figure 3: The effect of regular review on memory.

The underlying principle is to review material as soon as possible, and often - until it is secure in the memory. One schedule used effectively by some Trainees is to review work after one hour, one day, one week and one month. If using cards, for example, one way to establish this practice is to have a number of boxes for cards (such as the clear plastic card boxes available at newsagents) labelled 1/24, 1/7, 1/52 1/12. Cards are transferred from one box to the next when reviewed. A similar system could be established if studying with A4 sheets of paper, using folders labelled in a similar manner.

This all may seem daunting to the prospective student. One thing to make clear is that these suggested reviews need not be lengthy or comprehensive. Securing the main points of a topic after, say, a lecture or tutorial may take 5 - 10 minutes. The underlying principle is straightforward, that material needs to be reviewed while it is fresh in the memory.

This emphasis on review is the most significant principle to be grasped in understanding effective learning. If followed it has the potential to save Trainees a great deal of time.

Evaluation of Progress
Educationalists in recent years have been looking at ways to close the loop. That is to ensure that what has been taught has been learned. This may seem obvious, but in fact in the past we have not been systematic in checking that the desired learning outcomes have been achieved prior to examinations.

For Trainees to be effective learners they need to test their knowledge frequently, by themselves, with their peers and with their teachers. This testing is not for the
purposes of ranking or comparison (which can be threatening and unpleasant) but rather testing to ensure learning. Much of the information needs to be understood as apposed to being recalled. Explaining to others provides an opportunity to develop and test this understanding. Teachers can greatly assist in this process by providing frequent testing with appropriate follow up. It is far better to find out your limitations through a trial with a peer, Supervisor or teacher than it is during an examination.

Changing course material into a series of questions, and attempting answers unaided is a helpful start. Going over and “sitting” past exam questions is also immensely valuable. These questions also help define the syllabus and the depth of knowledge required. Unfortunately many Trainees leave this step until quite late in the exam preparation process whereas it should be an integral part of the preparation process from the beginning.

Common Faults
One of the most common faults in studying is to attempt too much in a particular study session. This is biting off more than can be chewed and consequently being unable to digest the material. It is far better to break the material into small pieces and learn each piece thoroughly.

A second fault is to keep tackling new areas of study without having consolidated recent work. There is a tendency to feel overwhelmed by the huge amount of material to be covered, and hence the student wants to at least cover everything once. A look at the Ebbinghaus forgetting curve will indicate the problems of this approach.

A third area for difficulties lies in being swamped by the detail of a topic before having established the main ideas. Learning in layers is more effective, that is starting with the most basic themes, moving through the topic, and leaving the detail until the main framework of the subject is firmly established.

Passive learning is not associated with rapid progress. Passive methods include copying out notes, reading (in an unstructured way) and listening to lectures. Active learning involves recalling past work, answering exam questions, presenting topics to fellow students and sitting trial vivas. One medal winning Part 1 candidate related that they would attempt a short answer exam style question the day after learning a new topic. This proven approach speeds learning dramatically.

There is a spectrum of activities between passive and active. The important issue is for the Trainee to be aware of what he or she is doing while studying, and to utilise the active end of the spectrum.

Another fault is for the Trainee to rush into studying without PLANNING. Sometimes the Trainee believes that sheer willpower and effort will get them over the line. While admirable in some ways, an alternative approach using “more brain and less brawn” will be more successful.
Psychological Problems Faced by Trainees
Trainees have high levels of anxiety about study and exams. They feel overwhelmed by the enormity of the work ahead of them. There is fear of being the one that does not pass, letting down partners, friends, family, teachers, Supervisors and the department. These feelings are present at times in a majority of Trainees. At times they can be debilitating.

Acknowledging these feelings in oneself and discussing them with trusted friends and teachers may be helpful. The assistance of trained professionals (for example, psychologists) should probably be sought more often that it is. The remedy, however, will always be to undertake systematic learning to raise confidence and self-esteem.

Most books on studying include sections on positive psychological strategies to enhance performance. These include fostering a positive self-image and visualizing success. Do these techniques work? Elite athletes and sports teams believe they do and choose to employ motivational coaches and sports psychologists.

Having a positive approach to ones abilities can be helpful. Students can formulate positive attitudes:
- “I am a powerful learner”.
- “I will be prepared and confident for my exam”.
- “With practice I will always get better”.
- “Every bit of work I do brings me closer to my goal”.

Writing these affirmations on cards and placing them around one’s study area can reinforce their value.

Conversely negative self-talk can be detrimental to progress. For example “I am a stupid idiot for not remembering that”. Or “I’m never going to pass this exam”. Recognizing such negativity for what it is, and replacing it with positive ideas is more helpful.

Trainees who put some time into examining these approaches may receive a very good return on the time invested.

Exercise 2
Trainees who have any doubts as to their ability to learn and perform well in their next examination should complete the following.
- Write four affirmations about your own ability to learn (for example, “I can learn anything”).
- Write four affirmations with a focus on desirable study habits (for example, “I will organise my study time effectively”).
- Place these affirmations on cards.
- Place these cards around your study area and read them with deliberation once a day.
Conclusion
There are a number of other areas in effective studying that will lead to significant benefit. These include:
• planning schedules,
• time management,
• selecting appropriate study locations, and
• working in groups.

Space prevents further discourse here, however, it is highly recommended that Trainees (and teachers) read further on these subjects.[See recommended reading]. Internet searches using key words like “study techniques”, “Cornell lecture notes”, “Ebbinghaus” and “memory” also reveal a wealth of information.

Trainees have much to gain by studying more effectively. Even a modest improvement in efficiency will free up time and energy for more fulfilling professional and personal lives.

Recommended Reading

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Tips for Effective Studying

- Allocate specific time for your studying.
- Build opportunities for study into your life.
- Maintain a positive approach to study and to your ability to learn.
- Divide large topics into manageable components.
- Master each component and then move onto the next component.
- Periodically review previously mastered components.
- Examinations are sources of stress, therefore take steps to minimise this stress. These steps should include:
  - Undertaking regular exercise.
  - Maintaining appropriate healthy nutrition and a balanced diet.
  - Allowing time for study, family, personal and work commitments.
- Commence preparing for an examination as much as 12 months prior to the examination date.
- Set aside a specific place to study in a quiet, well illuminated environment.
- Carry cards with you (such as those in Figure 2) and repeatedly test yourself unaided on their content.