

Lab Reports and Projects in Sport and Exercise Science

A Guide for Students

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note what your search terms and criteria were (see Section 2.2.1.i), include why the area of study is important and list any potential applications for the results. It may also be useful to note the areas that you will be covering to give an overview of the reviews structure and content (Bem, 1995). If you always have your research hypotheses in mind this can give you significant direction in your planning.

The second section is the main body of the review. Unfortunately there is no easy answer as to how to plan this section as all reviews differ depending on what you are studying and what you intend to develop for your rationale. An important tip is not to try to cover everything but also not to limit yourself by only using one or two key references (especially if you only obtained recent electronic sources). In this section of your review a literature summary table can be very useful. Each factor that has emerged may help you devise the main headings and subheadings within the text. Here subheadings are essential so that the reader knows exactly what they are supposed to be reading about. However, a common error here is when the text does not relate to the subheading. An error such as this can be overcome by careful proofreading and using the 'one word descriptors' for each of your paragraphs, as in Exercise 2.1, to ensure the content is relevant to the heading. An important point here is to note that for some research areas there may not be many articles relating to your research question. Students often struggle if there are no studies asking exactly the same research question that they have developed. This is not a problem – if there were similar studies why would yours be original? However, there will certainly always be a range of related studies from which you can develop your hypotheses. In addition, there are likely to be a number of key or opposing viewpoints on the subject area, and it is important to demonstrate that you know these and that you can back up and explain your decision.

The third and final section of the review should bring the review to a close, ending in a summary and your subsequent aims and hypotheses. Bem (1995) states that you should end a literature review with a bang rather than a whimper. What research has not been reported so far and which studies should be undertaken to bridge the gap in knowledge? Hopefully one of these suggestions will be related to your research hypothesis.

Exercise 2.6: Planning a literature review

Hopefully by now you will be happy with your research question and will be well read in the supporting literature. Consider the key themes within the literature and what factors have emerged as being important to the area. The suggestions in Section 1 and 3 below are simply to get you started in formulating or planning your review. For Section 2 revisit your literature summary table for key themes. Using these key themes is one approach that you may find useful. However, the content will vary with the area studied and your research question. Therefore, it is worth trying this approach even though you may use other methods to plan your literature review. You should always discuss the content with your supervisor.

Section 1

What areas will the review cover?

For systematic reviews, what search terms and criteria were considered?

Why is the area of study important?

What applications are there for the results of such studies?

Section 2

Consider the key themes as subheadings.

Section 3

What research has not been reported so far?

What studies should be undertaken to bridge the gap in knowledge?

Aims and objectives.

Hypotheses.

If you are struggling trying to plan your review, you may find it helpful to work backwards from your research question by considering what would be useful to discuss from specific to general points.

2.7.2 Writing a literature review

Once the key planning of your review has been done you can begin writing in earnest. At this stage you will have ideally read the literature, critiqued the studies and written or at least be happy with your research hypothesis. Essentially you will be adding detail to each of your subheadings. Note that your headings may well evolve as your writing does and your focus becomes clearer. Some headings may disappear and others may appear. Much of your writing will relate to the reporting and critiquing of research studies (see Section 2.8) and developing your research question so it is important that you are happy with extracting information from your literature sources (see Exercise 2.3). You must also ensure that you produce a clear overview. Reviews at undergraduate level often become either catalogues of information involving long lists of studies without any integration of key points or summaries of information with few links made between them. Try to avoid such an approach and make sure that you integrate your key studies together clearly and logically (see Exercise 2.3). If no one has reported an aspect of the area you are interested in it is perfectly acceptable to state that. However, in this instance you may have to think a little more laterally to try and develop aspects of your rationale.

Bem (1995) provides a helpful overview of scientific writing when considering literature reviews submitted to the journal *Psychological Bulletin*. Although literature review articles may differ from undergraduate and postgraduate dissertations the key aspects of scientific writing are essentially the same. Bem notes that a key factor differentiating between those articles accepted and rejected for publication is that of good writing and further notes that the primary criteria for good scientific writing are accuracy and clarity. For accuracy, ensure that any information provided is correct. Your supervisor is likely to know the details of many of the studies you are citing, and may well have written some of them, so they will know specific results and explanations. For clarity, make sure you state enough information to give an idea of the direction or magnitude or any previous results. For example, stating that 'ground reaction forces were different' is not very enlightening. Stating that 'ground reaction forces were greater during running than walking' or adding an idea of the size of such changes or absolute values provides a much clearer message to the reader. General writing tips are covered later in this text and it is recommended that you read that chapter while writing your review (see Chapter 6). The critique aspect of using literature is considered in Section 2.8.

2.8 Critiquing journal articles

The ability to think independently and critically is a key aspect of higher education (Ryall, 2010) and is particularly important in the final year of degree-level study. However, students often find critical analysis difficult. How do you go about beginning your critique of an article? How can you critique something that is already published? This section will hopefully provide answers to these common questions and give some ideas of how to approach the critical appraisal of a journal article or any other information source. Postgraduate students may find journal clubs or research seminar series quite useful for the discussion or critique of various journal articles or research studies, including their own.

What is critical analysis? Ryall (2010) notes that a critical thinker is able to make judgements based on sound reasoning. These judgements will depend on what is important to you and the sound reasoning is likely to relate to previous research findings and your interpretation of them. Young and Solomon (2009) state that critical analysis is a systematic approach used to determine the strengths and weaknesses of a journal article to assess both its usefulness and the validity of the reported findings. Greenhalgh (1997) states that critical analysis is the assessment of methodological quality. Importantly, Coughlan *et al.* (2007) note that critical analysis is not a criticism but an objective and balanced scrutiny of a piece of work, not only highlighting its strengths and weaknesses but to also ascertain whether the source is trustworthy and unbiased.

The majority of definitions of critical appraisal or critical thinking, such as those above, note that both the strengths and weaknesses of a source should be considered. Critique is not just pointing out negative or 'bad' points, it is also a consideration of what is new, novel and 'good'. Students can often be quite negative in critiquing work, but remember that if the research studies you read were truly 'bad' it is unlikely that they would have been published. Just because a study has not measured a variable that you are particularly interested in does not mean that it is bad, it probably just wasn't of key importance or interest to the authors. Furthermore, any criticism of other authors' work should be expressed in an objective manner (Wieseler and McGauran, 2010). Your critique should not be a demolition or 'trashing' of someone else's work (Ridley, 2008; Young and Solomon, 2009). Consider how you would react if similar comments were passed on your work.

So how do you go about critiquing a journal article? You have already done this at a basic level in extracting what you thought was important from the abstracts (see Exercise 2.4) and in establishing where gaps in the literature exist for your project area. Exercise 2.4 also noted that what you think is important may differ from what someone else considers to be important. Part of a critique is taking this one step further. Some authors suggest focussing upon the methods sections (Greenhalgh, 1997) and a lot of critique does indeed focus on the 'what did they do' aspects. Greenhalgh (1997) notes that most journal articles conform to the IMRaD principle, covering not only methods but the 'why did they do it?' (Introduction), 'What did they find?' (Results) and 'What do the results mean?' (Discussion) aspects. These other sections are also worthy of your critique.

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2.8.1 Critical appraisal tools

There are a range of critical appraisal tools available in the literature which may help develop your critiquing skills. More seasoned academics are unlikely to use a structured profoma when critiquing or reviewing journal articles, instead relying predominantly upon their research and publishing experience. However, for less-experienced researchers published guidelines will be of much more value. Guidelines and advice have been produced for the critical appraisal of journal articles in both quantitative and qualitative research in nursing (Coughlan *et al.*, 1997; Ryan *et al.*, 2007), physiology (Seals and Tanaka, 2000), psychology (Hyman, 1995), medicine (Greenhalgh, 1997; Young and Solomon, 2009), general practice (MacAuley, 1994), public health (Heller *et al.*, 2008) and physical therapy (Domholdt *et al.*, 1994; Maher *et al.*, 2004). Although all these guides are very useful, they were developed for specific research disciplines – there is no ‘gold standard’ procedure. Therefore, whatever process is undertaken must evolve with advances in methodological and non-methodological factors (Greenhalgh, 1997). To illustrate this point, when you read older journal articles or ‘classic’ studies and critique them for not using a particular technique, bear in mind that many techniques commonly employed today may not have been widely available at the time of writing. Differences also exist between quantitative and qualitative research processes and in the way the critique process should be approached for both (Ryan *et al.*, 2007).

More general models of critical appraisal provide general concepts for the appraiser to consider. For example, Deane (2010) considers seven points for the general critique of information sources, including whether the evidence presented is convincing and what level of subjectivity or bias exists within the work (Table 2.4). Similarly, Young and Solomon (2009) provide ten questions to ask from a clinical perspective, including whether the study is relevant and adds anything new and if any conflicts of interest exist, which is an important consideration in clinical drug trials (Table 2.5). Other more detailed models provide a greater number of specific questions to be asked within each section of the article (Heller *et al.*, 2008; Seals and Tanaka, 2000).

2.8.1.1 Critiquing and changing your professional practice

As noted above there are a large number of critical appraisal tools in the literature. Crowe and Sheppard (2011) compared 44 critical appraisal tools and concluded that users need to be careful about which tool they use and how they use it. The authors later developed their own critical appraisal tool (Crowe *et al.*, 2011a, 2011b). With this in mind an important aspect of critical appraisal is whether you wish to assess the scientific

Table 2.4 Seven questions to ask when critiquing an information source (Deane, 2010)

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1. Does the source use primary evidence?
 2. Does the source use secondary evidence?
 3. Is the evidence convincing?
 4. What are the author's credentials?
 5. What assumptions does the author make?
 6. What subjectivity or bias is evident in the source?
 7. Is the language emotive?
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Table 2.5 Young and Solomon's ten questions to ask when critically appraising a research article (Young and Solomon, 2009)

1. Is the study question relevant?
2. Does the study add anything new?
3. What type of research question is being asked?
4. Was the study design appropriate for the research question?
5. Did the study methods address the most important potential sources of bias?
6. Was the study performed according to the original protocol?
7. Does the study test a stated hypothesis?
8. Were the statistical analyses performed correctly?
9. Do the data justify the conclusions?
10. Are there any conflicts of interest?

Source: Young, J.M. and Solomons, M.J. (2009) How to critically appraise an article, *Nature Clinical Practice Gastroenterology and Hepatology*, 6, 82–91. Reprinted by permission from Macmillan Publishers Ltd.

rigour of an article (i.e. its quality or internal reliability) or how applicable the work is to your own practices (i.e. its value or external validity) (MacAuley, 1994; Maher *et al.*, 2004). The majority of undergraduate and postgraduate students in Sport and Exercise Science are probably critiquing with respect to scientific rigour as they are generally, but not exclusively, writing an academic piece of work. Conversely, students in areas such as Sports Therapy, and certainly professionals currently in practice, are more likely to be interested in how a piece of research may affect their treatments or clinical practices. The choice of critical appraisal tool is therefore extremely important. The following paragraphs will consider some aspects of both these forms of critical appraisal.

To help assess whether the scientific evidence considered will affect clinical behaviour or the practical approach to treatment, MacAuley (1994) developed the 'READER' aid to critical appraisal. This aid was initially developed for general practitioners with limited time to undertake extensive reviews of the literature (MacAuley, 1994). The 'READER' acronym stands for Relevance, Education, Applicability, Discrimination, Evaluation and Reaction, the main tenets of which are shown in Table 2.6. Each component is given a score and the usefulness of the information is graded according to the total score. This scale has been shown to be valid and reliable and has been used in a range of educational scenarios for general practitioners (Bleakley and MacAuley, 2002; MacAuley, 1996; MacAuley and McCrum, 1999; MacAuley and Sweeney, 1997; MacAuley *et al.*, 1998).

The main reason for introducing this scale here relates to the 'Relevance' component. A key factor of the component stresses that the article is assessed within the reader's own context, highlighting that what is useful for one reader may not be useful for another. Also, your needs may differ over time and in different situations. This is especially true if it has the potential to change your behaviour. Similar tools and appraisal advice have been provided for public health (Heller *et al.*, 2008) and physical therapy (Domholdt *et al.*, 1994; Maher *et al.*, 2004). Students of Sports Therapy may find these useful for the practical aspects of their courses. Even though the focus of these appraisal tools is towards that of potentially altering professional practice they still involve assessing the appropriateness of research questions and hypotheses, study design and the interpretation of results (Heller *et al.*, 2008), as well as the scientific or clinical basis of the work. Don't forget that changing professional practice

Table 2.6 MacAuley's READER aid to the critical appraisal of research articles (MacAuley, 1994)

<i>Component</i>	<i>Main factor(s) and scoring system</i>
Relevance	The article is assessed within the reader's context 1. Not relevant to general practice 2. Allied to general practice 3. Only relevant to specialised general practice 4. Broadly relevant to all general practice 5. Relevant to me
Education	Context of behaviour modification Could it change your behaviour? 1. Would certainly not influence behaviour 2. Could possibly influence behaviour 3. Would cause reconsideration of behaviour 4. Would probably alter behaviour 5. Would definitely change behaviour
Applicability	Can the research be done in the reader's own practice? Can you identify with the practice or circumstances? 1. Impossible in my practice 2. Fundamental changes needed 3. Perhaps possible 4. Could be done with reorganisation 5. I could do that tomorrow
Discrimination	Is the message valid? 1. Poor, descriptive study 2. Moderately good, descriptive study 3. Good descriptive study but methods not reproducible 4. Good descriptive study with sound methodology 5. Single-blind study with attempts to control 6. Controlled single-blind study 7. Double-blind, controlled single-blind study with method problem 8. Double-blind, controlled single-blind study with statistical deficiency 9. Sound scientific paper with minor faults 10. Scientifically excellent paper
Evaluation	If epidemiologically sound, paper should be considered seriously Score based on READ elements
Reaction	Scoring category (NB: the research is not necessarily 'bad', just not for your current needs) 24+ Classic paper which should make an immediate impact on practice 20–23 Paper is of value and filed for immediate access 15–19 Paper may be of interest <15 Paper failed to fulfil the criteria

Source: adapted from MacAuley, D. (1994) READER: an acronym to aid critical reading by general practitioners, *British Journal of General Practice*, 44(379), 83–85, Figure 1.

is not just limited to people working in clinical areas or with patients. The professional practice of sport and exercise scientists includes assessing why you use certain exercise protocols, questionnaires or data collection and analysis techniques. All of these may be affected by what you read in the literature.

2.8.1.ii Critiquing scientific rigour

Most students writing dissertations and compiling literature reviews are probably concerned with the scientific rigour of journal articles. Here, experience in research and writing is invaluable. However, most students will not have developed these skills to a large extent as they are in the early stages of their subject-specific research training. Many of the suggested critique questions within the various published critical appraisal guidelines parallel the advice given for writing literature reviews and the other sections of lab reports, dissertations and research studies. Seals and Tanaka (2000) developed a guide for critiquing scientific articles based upon the forum of postgraduate research seminars. The contents of the guide (Table 2.7) relate to most areas of sport and exercise science whether examined from physiological, psychological or biomechanical perspectives. If we compare this to the general model of critical appraisal the underlying themes are identical, it is the specifics that change with respect to subject discipline.

In conclusion, critical appraisal can take many forms and is specific to the needs of the reader at that time and the task they are set. All of the examples provided and guidelines given are essentially the same but focus on different aspects of critique. For example, Deane's (2010) questions are more general and assess the type of information source reviewed and its validity, whereas Young and Solomon's (2009) questions cover more discipline-specific considerations. Although MacAuley's (1994) critique is focussed mainly on the applicability of research to practice and the potential to change professional behaviour, as with Young and Solomon, the methodological aspects have a large emphasis on the overall score. In this context many reviewers would also have considered the specific points raised by Seals and Tanaka (2000) in evaluating methodological components. Similarly, any scientist assessing the rigour of an experimental design may subsequently decide to use that method. As long as you keep these guidelines and comments in mind, your critical appraisal skills will develop as you read and assess more information sources. Consider the aspects of each model presented here (but note that there are many more available) in relation to the stage of research you are at and put them into practice with the next article you read. Your critique skills and application of knowledge will then quickly develop.

Exercise 2.7

For a journal article obtained from your literature search use the different appraisal methods provided in this chapter to do the following:

1. Determine whether the article is useful for your literature review.
2. Critique the article using the specific criteria of Seals and Tanaka (2000).
3. Determine whether the article will affect what you do with respect to your research design.

Table 2.7 Critiquing a journal article (Seals and Tanaka, 2000)

<i>Section</i>	<i>Questions</i>
Title	Does title accurately reflect the purpose, design, results and conclusions of the study?
Abstract	Succinct, clear, comprehensive summary of the main text of the paper? Content consistent with that presented in the main text? Data or other key information presented here but not in the main text (or vice versa)?
Introduction	Succinctly states what is known and unknown about the topic? Functional, biological and/or clinical significance established? Specific experimental question, goal or aim to be addressed stated? Previous studies strengths and limitations described? Clear how experimental approach will provide unique insight?
Methods	Participants adequately described? Population appropriate for the research question? Participant number sufficient? Population used allow extensive or limited generalisability? Assignment of participants to conditions randomised? Ethical issues and consent described? Design allows hypothesis to be rigorously tested scientifically? Proper control groups/conditions included? Confounding factors controlled? Method described insufficient detail to be repeated? Measurement techniques reliable, precise and valid? Rationale for measures explained? Appropriate data calculation and analysis? Statistics appropriate for the study design? Statistical assumptions tested/violated? Alpha level clearly stated?
Results	Data reported in a clear, concise and well-organised manner? Where necessary are standard deviations and standard errors reported (any excess variability)? All data presented? Any data presented on any measurement not described in the methods? Are all the figures and tables needed? Tables and figures properly labelled with correct units and scaled appropriately? Any repetition of data in figure and tables? Is the data within the expected range? How do group differences compare to measurement variability?
Discussion	Major new findings clearly described and properly emphasised? Key conclusions adequately supported by the experimental data? Is there any alternative way to interpret the data? Significance of the results described? How do results extend previous knowledge? Observations for previous studies described in the context of present results? Statements supported by appropriate references? Data discussed with insight beyond previously? Unique aspects and other experimental strengths properly highlighted? Experimental limitations described so as to interpret the results appropriately? Suggestions for future work?

Source: Seals, D.R. and Tanaka, H. (2000) Manuscript peer review: a helpful checklist for students and novice referees, *Advances in Physiology Education*, June, 23: 52–58.