

Unit 9

Evidence from research

Unit aims:

- to understand attempts to explain the world through frameworks of academic concepts
- to investigate approaches to research in different disciplines
- to evaluate the quality of research claims and their supporting evidence
- to understand the link between theory and research design

Research is a fundamental component of all aspects of study at university, which makes it an essential element in a pre-session course. Students are not always aware of the importance of research when they begin their degree studies. This is especially true for students coming from a different educational culture, e.g., from secondary school to undergraduate degrees, or from an undergraduate degree in one country to postgraduate study in another. The content of courses at university is informed by current findings and debates in a research field. Students will familiarize themselves with problems and issues in their field by reading research literature and attempting to use these sources in essays and projects, thus simulating the process of knowledge creation. Both undergraduate and postgraduate students will usually be required to carry out research projects which enable them to display the knowledge and competence, i.e., the graduate attributes, they have acquired during their studies. By carrying out research, students come to understand that evidence and knowledge are contingent and will not be accepted in a field until they have been critically evaluated by the research community.

This unit builds on Unit 4, which showed how a research journey starts by reading around a topic. It shows how research evidence is collected, evaluated and used to support claims and build knowledge in a field. The concepts and language introduced in Unit 8 are recycled here. This unit begins by looking at how research claims are reported in the popular press, usually without sufficient references to the original studies which might allow a reader to find the original data and check its validity or reliability for themselves. The readers are presumed not to want to know and also not to have enough expertise to be able to consult the original sources, which is why the journalist has popularized the research for them. The second section considers how research is similar or varies across disciplines, while Sections 3 and 4 look at a detailed analysis of parts of a research paper, with the aim of showing how these parts fit together and how they can be read with reasonable scepticism. The structure and form of a research paper were introduced previously in Unit 2, Sections 3 and 4. They are examined here in more depth now that students have more resources to read critically. The final outcome of the unit is the critical evaluation of a research paper.

Note: If you are teaching an undergraduate-level class, it would benefit students to listen to the *EAP Pills* CD materials from *EAP Essentials* as a class at the beginning of Section 1.

Critical reading is a difficult task unless students have an in-depth knowledge of their research field, often not gained until the end of a course. Therefore, the contexts for evaluation in this unit are areas in which students are expected to have some personal expertise, e.g., the advantages and challenges of studying in the UK. The final section challenges students to review the framework for critically evaluating research, which has been built up throughout the unit, and to apply it to a research article they are reading.

Unit 9 Map

Unit themes	Functions	Texts	Academic language	Writing and speaking	Academic competence	Thinking critically
<p>Section 1 Communicating research transparently: where is the evidence?</p> <p>Section 2 Research across the disciplines: what counts as evidence?</p> <p>Section 3 Evaluating research: how good is the evidence?</p> <p>Section 4 The role of the literature review: linking theory to research design</p> <p>Section 5 Critical reading of a research paper</p>	<p>Linking evidence to claims</p> <p>Evaluating evidence and the methods that produced it</p> <p>Communicating research</p>	<p>Reading</p> <p>Newspaper articles</p> <p>Research papers</p> <p>Student projects</p> <p>Listening</p> <p>A lecture on research approaches</p> <p>A focus group discussion</p>	<p>Research terms: <i>cohort, control, conditions, variables</i></p> <p>Informal register for research quality: <i>reliable, robust, significant, elegant</i></p> <p>Reporting claims: <i>as predicted, it is well known</i></p>	<p>Writing</p> <p>Diagrammatic notes from a lecture</p> <p>A summary of two research papers</p> <p>Speaking</p> <p>Discussions: claims and research evidence</p> <p>Research types and quality</p> <p>Experience of being an international student</p>	<p>Understand and compare research designs</p> <p>Classify types of research</p> <p>Record points in a lecture and discussion</p> <p>Formulate research questions</p>	<p>Assess research evidence</p> <p>Identify stance in a paper or lecture</p> <p>Evaluate the quality of methods and results</p> <p>Identify limitations in research</p> <p>Draw independent conclusions from research data</p>

Section 1

Communicating research transparently: where is the evidence?

What the university expects:

- critical reflection – analyze and evaluate claims and evidence; an awareness of how knowledge is advanced – develop criteria for evaluating knowledge

Contexts:

- communicating research for study and work

Aims:

- to critically evaluate research claims reported in newspapers
- to understand how research evidence is used to support claims
- to understand how to evaluate the quality of research evidence

Background

Academic communities value evidence-based reasoning, and an academic argument is more persuasive if it is based on sound evidence, linked clearly to the claims. The main source of evidence comes from research in which data is collected systematically to answer a specific question or test a hypothesis. Before the findings from research can become accepted in a field, they must be subjected to critical questioning, usually focusing on the methods for data collection or the interpretation of the results. However, when research claims are reported in the popular press, the claims and the evidence are not always reported fully or in an appropriately nuanced way. This is usually done to make the findings seem more exciting or more widely applicable to the general population, and thus more interesting to read. This is one reason why newspapers are less reliable sources for academic essays. This section introduces the notion of evaluating evidence in a familiar context before moving on to look at authentic and hence more challenging research papers in later sections.



Depending on the level of study of your class, you may like a gentler introduction to research. For a group of students preparing for undergraduate study, you could ask them what they think research is. You might get some of the following stereotypes: research is something done in a laboratory, where researchers wear white coats and use test tubes; they use high precision instruments to take measurements which are accurate to several decimal places; research involves controlled, repeatable experiments. You could then use the *EAP Pills* CD classroom materials (index number 8.9) from *EAP Essentials* page 255, which provides an accessible introduction to the concept of controlled experiments.

Self study

Allow time for students to read each other's responses to the chosen assignment title. Refer students to the *Study smart!* writing an argument from data on page 224 for a checklist to evaluate the argument and the language in their texts. Collect and share ideas for the second Self study task about where Chen can find data for his assignment.

Lead in and discussion

Ask students what research findings they have read about recently in newspapers or seen on TV or the Internet, and whether they accepted the report at face value or questioned any of the information that was reported. Link your discussion to the unit and section titles, the aims and what the university expects of students to show that they will begin to evaluate research claims reported in the media.

Discussion



These headlines have been chosen to encourage students to begin thinking critically about research claims. The claims might all have an impact on the way people can live their lives, so they should be sure that they accept the evidence that supports the claims before they act on them. Your students may or may not be able to suggest the type of research that was used in each of the studies. You can record all reasonable answers for later confirmation following Task 5.

Answers

Headline 1: the author is certain – the strength of claim is shown in the absence of conditionals/modals.

research evidence: clinical trial with control and experimental groups.

Researchers would test for racism; look for significant differences in test results between the groups.

Headline 2: certain, but slightly hedged by *linked*.
research evidence: longitudinal study of mobile phone users which showed more incidence of cancer compared to general population.

Headline 3: certain, but some evaluation of finding with *surprise*.

research evidence: survey of people on Twitter and Facebook asking about attitudes.

Task 1 Evaluating evidence to support the strength of the claim

In this task, students begin to search for evidence to evaluate the claims in the headlines. For reasons of space, headlines are likely to be less nuanced than the article which follows, but the claims in the articles show a similar level of endorsement to those in the headlines. The articles provide only a brief outline of the research method as readers are assumed to be only interested in the findings. You can ask groups to choose an article and list information about the method that is not provided. Groups can be challenged to come up with the most detailed or longest list of missing information.





Answers

- 1.1** heart drug and racism:
claims in text more cautious than claims in headline
hedging devices: *may, suggests, appeared to be, Scientists believe*; stating limits or conditions: *'implicit', at a subconscious level* (not explicit)
mobile phones:
about the same level of strength of cause-effect: *linked, trigger, stimulated*
some distancing: *scientists found, a study found*, but reporting word *found* is neutral
social media:
about the same level of strength
distancing: *are often thought of, it turns out, according to a new survey* strengthening: *whopping, only*
- 1.2** heart drug and racism: clinical trial with control and experimental groups; need more information about a standard test for racism mobile phones: not clear how the study was carried out, but it seems to be on isolated cells in the laboratory, not in humans: *cell division, human cells*
social media: attitude survey of teenagers and adults
- 1.3** These are called 'scare quotes', which generally means a word is being used with a different meaning from normal. In this case, it seems 'implicit' draws attention to its opposite *explicit* and identifies a more limited impact for the findings. For 'dummy', this is a synonym for the technical word *placebo*.
- 1.4** Heart drug and racism: not clear who the volunteers were, e.g., mixed or homogeneous racial groups, or how many took part. Not clear what *scored lower on a standard ... test* means; not clear how findings were interpreted to reach a final conclusion.
Mobile phones: not clear what kind of human cells; need studies done on human subjects before generalizing *in vitro* (in glass, i.e., a test tube) findings to *in vivo* (in living subjects).

Social media: not clear how many people were surveyed or what questions they were asked. A definition of adult/teenager would be useful, as if a teenager is up to the age of 17 and an adult is from the age of 18, this is only a difference of one year; teenagers and adults might interpret *kind* differently; there appear to be two different meanings for *like*: *interested in* and *having a good time*.

Task 2 Thinking critically about implications for the general population

Research is reported in newspapers in a way which suggests that findings are applicable to all readers of the paper. However, this kind of generalization from a research sample to a whole population depends on how representative of that population the sample is and how rigorous the data-collection method was. There is not enough information about the sampling and data-collection methods to be sure that the results are sound. You can ask students to reflect on whether any of these claims would apply to them and if not, why not.

In the survey of social media, the researchers actually asked adults and teens a slightly different question, which could have affected the results. The author of the newspaper article seems to be claiming that just because they find people are kinder on Facebook, adults are more interested in it and enjoy using it more than teenagers. This is not justified as the question would not elicit this response. Note that *adult* is defined by the researchers as 18 or above, but not by the newspaper article, but the implication of *grown-ups* is that there is an age difference of more than one year.

Answers

- 2.1** Implications:
Heart drugs could be used to stop people holding racist attitudes.
People who use mobile phones might have a greater risk of cancer.
Adults like (i.e., are having a better time on) social networking sites more than teenagers.





It is not justified in all these reports, as there is not enough information about the sample and the general population or the way the studies were carried out.

- 2.2 Support from authority: *Scientists believe and claims about the activity of the drug in an area of the brain that controls emotions.*
- 2.3 Question asked: *Are people [your age] mostly kind or mostly unkind to one another on social networking sites?*

The findings are not reported accurately because of different interpretations of *like as interested in or having a good time.*

open

The researchers define an adult as someone aged 18 or over.

Study smart: supporting claims with evidence

The term 'reasonable scepticism' (Wallace & Wray, 2011) was introduced in Unit 8 and you can remind students that it is important to adopt this position when reading newspaper claims. A journalist sets out to entertain readers, whereas a researcher tries to persuade readers to accept claims about research evidence. Journalism doesn't demand such strict adherence to objective truth as research. However, not all research is methodologically sound or reported in a transparent way, and students also need to be reasonably sceptical of research reports.



Discussion

Students can discuss how worried they are about the possible dangers of mobile phones and what research evidence would make them stop using their phones. The *Guardian* column is called *Bad Science* because Ben Goldacre highlights and criticizes poor-quality research that is not methodologically sound or reported in a transparent way. Students can brainstorm topics they think the journalist will discuss.



Task 3 Reading quickly to understand the author's purpose

The article is about 700 words long, but it contains complex concepts and colloquial language so it is difficult to read quickly. Instead, you could ask students to think about where they expect the author to state his purpose (see Task 3.2) and then ask them to read just those sections. This encourages them to make use of their understanding of text structure to find information quickly. You can then discuss why **d** is the correct purpose and the others are not: the author states this purpose and the other purposes are not general enough to cover the whole article.

Answers

3.1 d

3.2 in the subheading: *make an informed decision*, and in the final sentence of the first paragraph which functions like a thesis statement: *the methodological issues*; also in the final sentence which sums up the report

Task 4 Reading carefully to understand the main points and assess your stance towards these

Students should first adopt a stance towards the claims and justify their position to their partner using evidence from the article. The second reading to determine Ben Goldacre's stance should help them to reach a more nuanced understanding of his claims.

Answers

4.1 open

- a disagree: para 3: *Phones are a potential risk ... People want information.*
- b agree: para 2: *authoritative utterances*; although he believes this trust is misplaced; *science isn't about authoritative utterances from men in white coats, it's about showing your working.*
- c agree: para 2: *showing your working*, but the report is not available
para 3: *People want information.*



- d** agree: para 3: *The word 'possibly' informs nobody; what are the limits of the research?*
- e** disagree: para 4: *it's a crude measure*
para 5: *that can be tricky*
- f** disagree: statement is too general – people find it difficult to remember back ten years ago
- g** agree: paras 8 and 9 – people do not remember, and things change over a long period so it is difficult to control variables
- h** agree: para 10 – a very small increase in risk

Task 5 Asking critical questions about research design

Ben Goldacre provides a clear contrast between two fundamental research designs: *inductive* (theory building) and *deductive* (theory testing). The purpose here is not to go into detail about research philosophy, but simply to highlight differences in approaches to research in different disciplines. This is considered in more detail in the next section. Students can work in pairs from different disciplines to complete the table and following tasks. Depending on the level of study, they might be able to provide examples of research designs from their field.

Answers

- 5.1** Prospective cohort study: people who do not have the disease; at the beginning of the study to determine what to measure; during or at the end of the study.
Retrospective case-control study: people who have the disease, plus a control group of people who do not have the disease; at the end of the study as a result of observed differences between the two groups; at the beginning of the study to inform the choice of subjects.
- 5.2** heart disease: prospective cohort study
brain cancer: retrospective case-control study
Choice is determined by the frequency of cases. Heart disease is common; brain cancer is rare.
- 5.3** Prospective study: you won't get enough cases.

Retrospective study: people might not give accurate reports because they have forgotten significant details; if it takes a long time for an effect to become apparent, it might be too early to see an association; mobile phone technology changes over time so the study might show a 'false positive' = a false alarm, or a 'false negative' = false reassurance.

- 5.4** Prospective study: general to specific – a general idea about what factors could be involved determines what to measure.
Retrospective study: specific to general – identify specific cases first and look for general patterns.

5.5 open

You can ask students to compare their ideas from the discussion at the beginning with what they now understand as a result of working through these tasks so that they can reflect on how their understanding of research has changed.

Study smart: critically evaluating research

The article provides a very clear framework for evaluating the quality of research findings. You can elicit the criteria from students before reading the Study smart framework together.



Task 6 Thinking critically about limitations

Tasks 4 and 5 looked at transparency of reporting and research design, so this task focuses attention on the research limitations mentioned in the article. Students can use the Study smart framework as the basis for critical evaluation of research in their field.

Answers

Examples from the article of problems or limitations:

... you won't get enough cases appearing in your study group to spot an association with your potential cause.

... such studies are vulnerable to the frailties of memory.





... we've only got data for 10 or 20 years, so the future risk may be unknowable right now ...
 ... phones change over time ...
 ... we might get a false alarm, or false reassurance ...
 ... the issue of a large increase in a small baseline risk.

Kinds of problems shown by the examples:
 sampling (1): the sample size is too small to see a pattern
 measurement (2, 3, 4 and 5): unreliable reporting – memories are influenced by outcome; not enough time has elapsed to see an effect; changes in the amount of radiation from phones over time; false alarm (false positive) and false reassurance (false negatives)
 interpretation (6): misleading use of statistics

- f to be difficult, problematic, complex
- g to notice, recognize, detect, determine, find
- h this seems to be simple, straightforward, obvious
- i that resulted in
- j it is true that (signals a fact that contradicts a previous point)

Task 7 Noticing language: contrasting formal and informal features of the article

The article is written in a very conversational style because it appeared in a newspaper, but a lecturer might choose this style to motivate and interest an audience of students. It contains a mixture of formal and informal language because the topic is academic, but the purpose is for entertainment. You can see Ben Goldacre give a similar talk online: https://www.ted.com/talks/ben_goldacre_battling_bad_science.html. You could ask students to listen to this once they have completed the tasks to show that prior reading and thinking make listening to lectures easier.

Answers

- a to bring to attention, signal, give rise to, demonstrate, show, reveal
- b to explain, demonstrate, reveal, share methods so others can evaluate them
- c to provide evidence, expand on, interpret
- d an approximate or rough measure
- e many different factors or variables

Self study

Students may wish to explore the evidence linking mobile phone use and cancer in more depth using the references given. Alternatively, they could take one of the research papers they found in Unit 4 and returned to in Unit 8 and analyze it using the Study smart: critically evaluating research framework on page 232. They may only be able to identify criteria which the report discusses explicitly, e.g., limitations, but this should raise their awareness of where to look to find evidence of quality.

Vocabulary exploitation

Research of the kind that Ben Goldacre highlights looks for associations, correlations and direct causes. The article contains a lot of nuanced language to express these cause-effect links. You can ask students to highlight this language and say how strong or weak the possible cause-effect link is, e.g., *The report has triggered over 3,000 news articles* shows a strong link between the report and subsequent articles about it, whereas *phone use overall was associated with fewer tumours* shows weak commitment to a possible link between mobile phone use and cancer.

Section 2

Research across the disciplines: what counts as evidence?

What the university expects:

- an awareness of how knowledge is advanced

Contexts:

- collecting data for research

Aims:

- to understand approaches to research in different disciplines
- to identify a lecturer's stance towards the material he is presenting
- to take notes in order to apply ideas from the lecture to specific examples

Background

This section introduces and problematizes the concept of cross-disciplinary research, introducing three dimensions: hard–soft, pure–applied and life–non-life. These are drawn from Fanelli's (2010) *'Positive' results increase down the hierarchy of sciences*¹, which discusses a number of different ways of categorizing research. The dimensions are used to raise students' awareness that different disciplines adopt different approaches to research. This section also explains in more detail and in terms of research how to 'operationalize' concepts, which was introduced in Unit 8, Section 4. This prepares students for the critical evaluation in Section 3.

Self study

You can allow time for students to compare their analyses of their chosen research paper. In particular, they should discuss where in the paper they found limitations in sampling, measurement or interpretation of the data.

Lead in and discussion

Ask students if they are aware of the terms 'hard' and 'soft' to refer to different research disciplines. Link your discussion to the section title, the aims and what the university expects, so that your students are clear that they will be listening to a lecture about the different approaches to research in different disciplines.

Discussion

Depending on the experience and level of study of your students, you may wish to focus on the diagram first and elicit students' understanding of the different dimensions of research before they read the introduction which explains these terms. Even undergraduate students should be able to say whether their discipline is concerned with the real world or the theoretical and abstract world (applied or pure) or whether its objects of study are part of the living world. The hard–soft dimension is explained further in the lecture.

Task 1 Classifying approaches to research

This classification and subsequent discussion of their own discipline prepares students to understand some of the points that the lecturer makes about the type of research it is possible to carry out in different disciplines. Students might disagree about where on the diagram they would place each research paper, e.g., **1** is similar to **4** since both use models and simulations to investigate the impacts of climate change, but **1** is more applied in that a location for the study is specified.

In terms of the challenges of cross-disciplinary research, the main difficulties involve the different ways, for example, scientists and social scientists view the world and how they collect data (evidence). As an example of different ways of viewing the world, you can ask students to think about what a university is. Does it have a reality which is separate from the interactions of the individuals within it? A university has tangible components: a founding charter, buildings and classrooms, written regulations, student assessment results and degree transcripts. However, by themselves,

¹ Fanelli, D. (2010). 'Positive' results increase down the hierarchy of sciences. *PLoS ONE*, 5(4): e10068. DOI: 10.1371/journal.pone.0010068.



these are not enough to fully characterize a university. It also has interactions – between students, teachers and support staff in classrooms, examinations and graduation ceremonies. These events are dynamic and intangible, but are nevertheless real. The approach to data collection in this type of context would be different depending on whether a researcher wanted to measure achievement by measuring exam results or by asking students about the quality of their experiences.

Answers

- 1.1**
- 1 hard, applied, non-life
 - 2 soft, applied, life
 - 3 soft, applied, life
 - 4 hard, pure, non-life
 - 5 hard and soft, applied, life
 - 6 hard, applied, non-life

1.2 and 1.3

open

- 1.4** challenges: different ways of seeing the world and collecting evidence

Disciplines in which cross-disciplinary research is easier are more likely to be towards the centre of the diagram.

In terms of agreement with the lecturer's stance, students from disciplines towards the extremes of the diagram will perhaps be much less aware of how research is carried out beyond their own discipline, e.g., physicists tend not to be aware of the approach to research in the humanities and vice versa. Disciplines towards the centre, e.g., urban design or human-computer interaction, may already use mixed methods, in common with other disciplines. Social science worries about the difference between deductive and inductive approaches, whereas physics is hardly aware of this argument.

Answers

- 2.1** To find common ground in order to forge links and develop joint research projects. Important because research in future will be collaborative.
- 2.2** The process of research and knowledge building is similar across disciplines; the objects of study, types of problems and data collected are different.
The lecturer has experience of three disciplines.
- 2.4** open
The disciplines near the centre of the diagram are more likely to collaborate or use a variety of methods; those near the edges are less aware of other research approaches.
- 2.3** open

Task 2 Listening to identify the stance of the lecturer

ⓂT59, Transcript p294

Research into students' listening and note-making strategies has found that students tend to assume that the purpose of lectures is simply to transfer information from lecturer to student. The aim here (as in Unit 7, Section 2) is to challenge this assumption. The lecturer explicitly states that he is going to argue that there are similarities as well as differences in approaches to research and he invites his audience to evaluate to what extent they agree with his thesis. Expert listeners will adopt a stance and be able to compare each point the lecturer makes with their own position. You can ask students to think about the argument structures they studied in Unit 8 as the lecturer is likely to make a series of points in his argument. He will introduce each point and then provide examples to illustrate and explain what he means. His evidence is likely to be descriptions of different approaches to research.

Task 3 Thinking critically about direct and indirect measurement

This task prepares students to listen to the lecturer's examples about operationalizing research, which essentially means making a measurement that relates to the concept of interest indirectly because it is not possible to measure the concept of interest directly. The first example given is the measurement of the depth of water in a well. Most students can probably suggest dropping in a stone and counting the seconds until the splash, even if they have not thought of this as an indirect measurement. It uses time (and terminal velocity) to measure distance indirectly. The other examples use concepts from trigonometry (and hence surveying) or physical chemistry. You can make use of your students' expert knowledge to explain these two types of indirect measurement.



Direct measurements require a measuring device which has the same scale as the object to be measured, e.g., a ruler to measure the length of a sheet of paper. Indirect measurements are required when the distance is very large, e.g., between two mountain peaks, or very small, e.g., between two atoms in a crystal structure.

Task 3.4 prepares students to listen to the examples of operationalizing research concepts which the lecturer uses to illustrate his point about the differences between disciplines. You can record students' suggestions as to what is being measured and then ask them to listen for the answer in the second part of the lecture.

Answers

- 3.1 Drop in a stone and count the seconds before the splash – uses time and terminal velocity to measure distance indirectly.
- 3.2 Use a surveying method called triangulation, based on the relationship between the length of the sides and the angles of a triangle. A baseline of a known length is measured, which acts as one side of a triangle. From each end of the baseline, the angles to each mountain peak can be measured. This creates a series of adjacent triangles whose angles and sides can be measured.
- 3.3 To measure the distance between two atoms requires a measuring device of a similar size. X-rays are used since these have a wavelength similar to the interatomic distances. When X-rays collide with electrons in a crystal structure, they are scattered. For visible light, a lens could be used to focus scattered rays, but there are no lenses which can focus X-rays, so instead, electronics and calculations are used to produce an indirect image that can be measured.
- 3.4 Both these diagrams show the use of a direct measurement of distance to provide an indirect measurement of water quality or social interaction.

Task 4 Identifying the lecturer's main points and taking notes

T60, Transcript p294

In this task, students should try to identify and note down the points in the lecturer's argument, rather than simply record the topics covered in the lecture. For students whose listening skills are weaker, this is difficult because it requires them to pay attention to the structure of the presentation at the same time as they are attending to the content. There is a sample set of notes in Appendix 9a, p253, which lists the main points, and you could ask weaker students if they wish to study these first before they listen. It is important in lectures which argue a point for students to adopt a position of reasonable scepticism and not accept the lecturer's points at face value. The lecture is delivered in this way in order to model the way argument and debate is used to build knowledge in a field, so if they can be made aware of this, students can understand how their discipline evaluates claims and evidence. You can encourage students to find even small points of disagreement in order to build their confidence.

It is also important that students can report orally on what they have heard in a lecture, as this shows they have understood the content. They are asked to choose an example which is not related to their field so that they have to think more carefully about how to explain it. You can ask students to work in small groups and then report back to the class. As each group reports their example, students from that discipline can be encouraged to challenge their interpretation.

Answers

4.1 and 4.2

See Appendix 9a, p253 for sample notes.

4.3 and 4.4

open



Task 5 Applying ideas from the lecture to understand approaches to research

An important graduate attribute which students develop during their studies, particularly at postgraduate level, is the ability to understand the theories, concepts and ideas they are being taught and use these to inform their real-world practice. The research component of their degrees is intended to develop this ability. Here, students are asked to apply ideas from the lecture by first drawing a diagram of research approaches and then applying the ideas to specific studies which they have read in previous sections. Additional support can be provided by asking students to consult the transcript or giving out the sample diagram in Appendix 9b, p254, without the labels for students to complete. Students can work in pairs on the abstracts to find evidence for their answers to the tasks.

For students who already have experience of research, you could elicit different types of variables² in preparation for Task 5.3:

- Independent variables answer the question, *What conditions do I set up or change?*
- Dependent variables answer the question, *What outcomes do I observe or measure?*
- Controlled variables answer the question, *What do I keep the same?*
- Extraneous variables answer the question, *What uninteresting variables might interfere with the effect of the independent variable on the dependent variable?*

The researcher's aim in a deductive approach is to show a causal link between independent (cause) and dependent (effect) variables, which is not influenced by the controlled or extraneous variables. Science, engineering and social sciences students may have a better grasp of these concepts than students in disciplines such as the humanities, so you can use the expertise you have in the class as well as referring back to the lecture to help explain these concepts.

Answers

- 5.1** See Appendix 9b, p254 for sample diagram.
- 5.2** Abstract 1: deductive – researchers used hypothetical scenarios in general circulation models and water balance models to derive

the variables in the study and test the performance of a model

Abstract 2: inductive – no hypothesis; aim is to understand social interactions rather than look for causes of behaviour

Abstract 3: inductive – research aim is to discover common traffic problems in China and compare to those in Sweden

Abstract 4: deductive – researchers use models of noradrenergic mechanisms to produce a hypothesis and compare experimental and control groups

5.3 Abstract 1: conditions changed in incremental steps (independent variables): temperature and rainfall outcomes measured (dependent variable): runoff

Abstract 2: measured frequency: negative or mean or unkind behaviour; researchers counted answers to binary [+ or -] questions – mostly kind or unkind

Abstract 3: measured frequency: most common traffic problems; researchers were trying to understand driver behaviour and its impact on the design of ADAS

Abstract 4: conditions set up (independent variable): administration of a drug (propranolol) or a placebo

outcomes measured (dependent variable): test responses on a standard test of implicit racial attitudes

Note that the researchers did not set out to measure explicit racial attitudes.

5.4 open

Self study

In preparation for the next section, students can use the article they selected in Section 1 to begin to identify the research design and the variables that were measured. In Section 3, they will be taken step by step through a critical evaluation of the methodology and results sections of a paper.

² Available online from http://en.wikipedia.org/wiki/Dependent_and_independent_variables



Vocabulary exploitation

You could work with students to identify signpost expressions in the transcript of the lecture which indicate that the lecturer is moving to a new point. He often summarizes a previous point which allows him to move to the next point, e.g., *I've presented this story of the search for new knowledge in the field of astronomy as one of continual progress in research*, and you could ask students to identify these summaries and to listen out for them in lectures. The lecturer also uses expressions which state his aims explicitly and connect him directly with his audience, e.g., *What I'm going to argue ... and you'll be able to evaluate this thesis and decide to what extent you agree with me*. Again, students can locate these in the transcript and record them for use in their own presentations.

Background

Unit 8, Section 2 introduced students to the concept of reasonable scepticism 'being open minded and willing to be convinced, but only if authors can adequately back their claims' (Wallace & Wray, 2011). It provided a critical reading checklist to help students critically evaluate claims in a text and select information for writing purposes. This section applies aspects of the critical reading checklist to extracts from two research papers. The topic chosen is the globalization of education and internationally mobile students because your students are likely to have some experience in this area. They may not feel they have the right to critically evaluate research papers, so the discussion is intended to show them that their experience gives them this right. This section and the next one delve more deeply into critical evaluation of specific parts of a research paper to prepare students for Section 5, where they evaluate a paper of their own choosing.

Section 3

Evaluating research: how good is the evidence?

What the university expects:

- critical reflection – analyze and evaluate claims and evidence; critically evaluate the quality and impact of others' work

Contexts:

- reading research papers

Aims:

- to understand how to evaluate the quality of research evidence
- to compare and evaluate the research designs in two studies with similar aims
- to interpret the findings from the studies in terms of your own experience
- to write a critical review of the studies which highlights a gap in the research

Self study

You can allow time for students to compare the research methods in their chosen research paper. Check if they can identify the research design – inductive or deductive – and how the researchers define the variables which they want to measure.

Lead in and discussion

Ask your students how they feel about critically evaluating published research and try to elicit reasons for any reluctance. Link their responses to the section title, the aims and what the university expects, so that they are clear that they are expected to evaluate published research in order to prepare for their own research project. In the first stages of their degree, they build knowledge and expertise which gives them the right to be reasonably sceptical about published research.



Discussion



The aim of this discussion is to raise students' awareness that they have expertise in this particular research area because of their own experience – or that of their friends – as internationally mobile students (IMS). The term IMS is more neutral than 'international student' or 'overseas student'. Students from the UK or USA could be IMS if they studied in other countries. International or overseas students require a reference point, i.e., the UK, and implies a contrast with a home student.

Answers

Disadvantages might be lower proficiency in language for study, differences in the education cultures between home country and the UK, but also personal motivation and wellbeing, e.g., feelings of homesickness or time taken to settle into a new environment.

Study smart: reasonable scepticism in research



Remind students of the term *reasonable scepticism*, which was introduced in Unit 8 and is particularly important in research where new ideas are being put forward for debate. Students may be reluctant to criticize a published research article, but you can explain that the author's purpose is not to describe facts, but to build an argument in order to convince readers that the claims made on the basis of the research are reasonable. Readers are expected to question the findings based on their own experience and to critically evaluate the author's interpretation.

Task 1 Adopting a position of reasonable scepticism

The purpose is to encourage students to evaluate these claims on the basis of their own experience. For the purposes of the task, the claims have been changed to show a greater level of endorsement than in the original articles. Note that the questions here are similar to the ones for the newspaper claims in Section 1. You can point this out to students and encourage them to take the same position towards these claims as they did for the newspaper headlines. Answers will become apparent as students work through the section. In general, you can encourage students to see that Claim 1 might be reasonable (and could be shown by comparing UK students with IMS in terms of performance data such as scores for coursework and exams) and Claim 2 is a stereotype which suggests that all IMS come from education systems where rote learning is preferred and that this is an inferior kind of learning. Claims 3 and 4 are in some respects self-evident, i.e., common knowledge, and do not really need research data to support them.

Answers

Open; all claims are expressed with a high level of certainty. Claim 1 is a reasonable and interesting claim, Claim 2 is a stereotype – not all IMS are like this, Claim 3 is somewhat banal and Claim 4 is a general stereotype.

Task 2 Understanding the purpose of the research

This task introduces the aims of the two studies. It is important to point out that not all the questions can be answered using just the information in the paper titles and abstracts. Students are sometimes tempted to read only the abstracts of research reports in order to reduce their reading load. However, a position of reasonable scepticism is only tenable if students have

read each paper more deeply. In the case of these two articles, Kelly and Moogan have a reasonably clear aim, but, as will become evident later, Lebcir et al. have a different aim from that stated in their abstract. They claim to be measuring a variety of factors related to teaching style, communication and language proficiency and assessment type, but they are in fact measuring students' perceptions of whether these factors affect their academic performance.

Answers

- 2.1** Kelly and Moogan study: postgraduate students, but we don't know what courses
Lebcir et al. study: project management courses, but we don't know what type of student
- 2.2** Kelly and Moogan: performance, i.e., scores in exam, coursework and dissertation
Lebcir et al.: factors that affect students' performance
- 2.3** Kelly and Moogan: education systems; UK students or IMS;
assessment type: coursework, exams, dissertation, time, i.e., transition period
Lebcir et al.: teaching style: level of details given in lectures, speed of lectures
English language and communication: academic Internet sources, English language skills assessment methods: group or individual assessment, qualitative/quantitative content of assessment
The factors appear to be similar, but are in fact quite different.
- 2.4** Other factors might be personal to individuals, e.g., homesickness, or previous experience of the subject.
- 2.5** Kelly and Moogan: over 15,000 postgraduate assessments from UK students and IMS
Lebcir et al.: international students on project management courses
- 2.6** Kelly and Moogan: performance measured as scores on coursework, exams and dissertation
Lebcir et al.: conceptual framework developed and empirically tested – not clear from the abstract how this was done
- 2.7** The titles and abstracts do not provide enough information; students need to read the methods and results sections.

Task 3 Comparing the research designs

Students now need to read the methods and results sections very carefully to interrogate the research with reasonable scepticism. You can point out that this type of research is very difficult to operationalize – as mentioned by the lecturer in Section 2 – and students should expect to find some problems with the research design. Students can work in pairs to complete the table and compare it with the sample table in Appendix 9c, p255. For less proficient students, you could give them the completed table and ask them to locate each answer in the texts. The key aspect to bring out here and in Task 4 is that although Lebcir et al. claim to be measuring factors which affect academic performance, they do not give any data to show students' performance (unlike Kelly & Moogan), and they are in fact measuring students' perception of possible factors. Furthermore, they have selected the factors themselves, rather than asking the students what these might be. This has an impact on the validity of their study.

Answers

- 3.1** See Appendix 9c, p255 for sample table.
- 3.2** Research location and stated aim (factors affecting performance) are similar; Kelly and Moogan compare the UK and IMS over a period; additional aim: to understand transition period for IMS.
Lebcir et al. measure students' perceptions of factors that might affect their performance, not actual performance. Independent variables, sample size and type and research design are different.
Study experiences of IMS (teaching, assessment) are similar.
Specific characteristics of IMS (age, gender or language and communication) are different.
- 3.3** Kelly and Moogan: variables are student status (IMS or UK), age, gender and grades for assessments; relationships between variables analyzed using a statistics software package (SPSS); differences in performance shown by differences in outcomes (grades) for different groups in the sample, i.e., IMS or UK students, men or women of different ages; transition period shown by comparing grades for coursework and/or exams in semesters 1 and 2 and grades for dissertation in semester 3.



Lebcir et al.: used statements of opinion with a scale from one to five (1 = strongly disagree, 5 = strongly agree); student perception of factors affecting performance are the ones that they strongly agree with (note these are not necessarily the only factors, just the only ones Lebcir et al. chose to present; they do not measure performance, but only students' perceptions). Lebcir et al. are not precise in labelling the variables.

Study smart: reliability, validity and credibility



These terms are defined in the Study smart in order to provide further questions for a position of reasonable scepticism. You can discuss these questions with your students so that they understand the kinds of answers they should expect. You may also like to relate these questions back to the *Bad Science* article by Ben Goldacre to see which limitations or problems of the research he reports are problems with reliability, validity or credibility.

Task 4 Critically evaluating the research designs

Students will receive training in research methods on their degrees to help them understand concepts such as reliability, validity and credibility of research. The intention here is simply to problematize the research designs to give students confidence to read the articles critically. The larger the sample, the more confidence there is in the reliability of the results. Lebcir et al. recognize that the problem of small sample size severely affects their study.

It is difficult to operationalize concepts in social science research and also difficult to sample reliably. Both these studies are based on convenience samples, i.e., what was available to the researchers. The best way to sample is probability sampling, in which each member of a population has the same chance of being selected for the sample. This is difficult to achieve and almost impossible for most student projects in this discipline, so other sorts of samples are used. Usually researchers explain what type of

sample they used and how that might affect their results. You can encourage students to think about variations in the sample which the researchers did not measure or control: Kelly and Moogan: country of origin, teaching content and assessment methods and whether these were consistent year on year; Lebcir et al.: country of origin, previous educational experience, age or gender. These could be extraneous variables.

Although the Kelly and Moogan study is more precise in operationalizing its concepts, it is descriptive, measuring factors such as age and gender. These are useful in tracking student performance, but could not be manipulated in order to improve this. Kelly and Moogan actually call for further research in a qualitative direction and this is what the Lebcir et al. study sets out to achieve.

The question of generalizing relates to the sample selection. If a probability sample is selected, then it can be said to be representative of a whole population and findings can be generalized. You may need to explain the UK university system in which post-92 universities were former polytechnics and colleges which gained university status from 1992 onwards and were able to award degrees. Students will likely be aware of the league tables, published by the *Guardian* and other newspapers, which rank universities. It might be expected that more language-proficient and cognitively-able students are accepted to higher-ranked universities, so the results from studies at post-92 universities are not representative of students in other institutions and the results cannot be generalized.

Answers

4.1 Kelly and Moogan assume each cohort has similar characteristics year-on-year with no changes to countries of origin for IMS, teaching styles, course content or assessment in that time. Lebcir et al. received a very low response rate, so there is no way of knowing if the responses received were representative of the whole group. The study is possibly labelled a 'case study' because of the small number of participants. Countries of origin and hence educational background are not reported in either study.



- 4.2 The Kelly and Moogan sample size is much larger – in fact, the whole student population between the years specified; data collected is easier to measure consistently, e.g., assessments have quality control checks before scores are entered into the student record system.
- 4.3 Kelly and Moogan, who operationalize academic performance through assessment scores.
- 4.4 Kelly and Moogan: study focuses on student characteristics such as age and gender and on time (transition period). These are factors that cannot be changed to improve the student experience.
Lebcir et al. do not operationalize academic performance, but do provide factors which could be changed to improve the student experience, e.g., pace of lectures, and elicit students' opinions about these; factors were chosen by the researchers, who did not ask students to provide any other factors that were important to them.
- 4.5 No, they could not be generalized to other university contexts.

Figure: IMS with previous experience of studying in the UK initially do much better in assessments than IMS new to the UK, but this gap closes in semester 3 when students are doing a dissertation.

- 5.2 Interpretation is open, but reference could be made to the transition period when students are settling in and to issues such as knowledge of language and education culture.

Task 6 Comparing your interpretation with that of the authors

In this and the next task, the students will see the claims they discussed at the beginning of this section repeated in the extracts from the results for each article, albeit in a more nuanced way. They should first assess the results shown and draw their own conclusion before comparing with the authors' conclusions. The authors of both studies overgeneralize about the reasons for the results of their studies. They do not provide enough evidence for these speculations.

Task 5 Drawing conclusions from the findings of Kelly and Moogan (2012)

The principal findings and the commentary on these are now presented in turn for each of the studies. It is important that students interpret the results for themselves before comparing their interpretation with that of the authors. You can encourage any imaginative interpretations of the data, but ask for reasons.

Answers

- 5.1 Table: mean scores for home country students in the first semester are ten points higher than those for IMS and 13 points higher for coursework over the year. The gap between IMS and home students for exam scores is much smaller – only four points.

Answers

- 6.1 *This may suggest that the transition period continues beyond the end of the first semester and into the second semester (and longer) whilst the IMS are still adapting. ... (which may be due to their prior higher education background where rote learning is more common) ...*
... which may be due to settling in faster and or being better equipped to interpret communications from the tutor due to already knowing the 'rules'. 6.2 Evidence for the transition period is the gap between scores for IMS and home students or IMS with previous experience.
All other interpretations are speculations based on the researchers' own knowledge and not on any of the data.
- 6.3 Open, but encourage students to challenge stereotypes, e.g., IMS better at rote learning.



Task 7 Critically evaluating the findings and conclusions of Lebcir et al. (2008)

This study seems to be badly designed and the authors are inconsistent in the way they label the dependent variable, e.g., it changes from 'academic performance' in the title and abstract to 'capture student opinion' in the methodology. The statements they used also led to inconsistent results: statements 2 and 3 appear to be opposites, but the majority of students disagree with both. It is possible that the students were answering that they thought the pace was about right, so they disagreed with both statements, but it is not possible to check this. Compare these responses with statements 15 and 16 which are also opposites, but where most students seemed to choose neither agree nor disagree. The commentary which accompanies these results is also inconsistent with the discussion that follows. The researchers make generalizations which are banal or for which they do not have evidence from the results, e.g., *international students are not a homogenous group and the ability of students to interact with others and their previous experience in teamwork is different depending on the country of origin of the students and the subject they studied before coming to the UK*. This latter statement is prefaced with *It is well known*, but no sources are given and there is no evidence in the data to support this. This kind of claim with its lack of evidence is in fact typical of much student writing.

You can refer students back to their initial discussion at the start of this section and what they thought the disadvantages were for IMS. Some of these might be used to explain the findings in these studies.

Answers

7.1 Inconsistency in statements 2 and 3: *the mean score [...] are almost identical, although there is more agreement with the latter statement*. They cannot be identical and different (more agreement) at the same time.

Inconsistency in statements 15 and 16: opinions are equally divided between more bias towards group assignments and it is unclear from our results whether students prefer group assignments.

7.2 The scale has only five points and students are likely to have chosen only a whole point (depending on the way the questionnaire was laid out). An equal interval scale cannot be assumed, so there is no justification for calculating mean to two decimal points. Data could be reported in a bar chart to show numbers at each point on the scale.

7.3 The style of lecture presentation is a strong factor: support – mean/median above 3.0. International students have different abilities and strengths: support – opinion divided between two opposite statements.

It is unclear whether students prefer group work: support – opinion divided between two opposite statements.

Claims in the discussion section are the authors' opinions, with no indication of the country of origin of respondents and no analysis of the data on this basis.

7.4 Open, but you could mention that students might have a wide range of language proficiency and subject knowledge which might be confounding variables.

Task 8 Writing a summary of the research which indicates a gap

Students have been guided through a critical evaluation of these two studies, which both aim to understand more about the international student experience. The authors of both studies identified sampling as a key limitation for their research. Students now have enough information about the method for each study to enable them to critically evaluate these studies in the light of their own experience. You can support this task by having students write in class, where you can monitor the activity and answer questions, or ask them to write it themselves for homework. They should use the checklist from Unit 8 to evaluate how well their voice is heard in their own and their peers' writing.



Answers

- 8.1 See Appendix 9d, p256 for sample summary.
- 8.2 open
- 8.3 This summary could form one part of a literature review for a new study, but the author would have to use the literature to define concepts such as international student and refer to a wider range of literature to set the context.

Self study

Having been guided through a critical evaluation of methods and results, students should now be able to recognize critical evaluation presented in other research papers they read. Normally it is found in the introduction section and is intended to identify a gap in the previous research which can be filled by the current study.

Vocabulary exploitation

The extracts from the research articles contain language for data commentary, reporting research claims and linking them to evidence from the studies. Examples include *evidence of [academic disadvantage]*, *[evidence] suggests that*, *[evidence] may be due to*, *[finding] is supported by the fact that*, *[findings] may be explained by the fact that*, *it is unclear from the results*. Your students can identify this language, record it and try to use it in their critical summary.

Section 4

The role of the literature review: linking theory to research design

What the university expects:

- awareness of how knowledge is advanced; understand complex relationships between observations, evidence and theories

Contexts:

- writing literature reviews

Aims:

- to understand attempts to explain the world through frameworks of academic concepts
- to understand the purpose of a literature review in linking theory to research design
- to listen and take notes in order to align your viewpoint with what the university expects
- to apply concepts from a focus group discussion to case studies of student projects

Background

A major weakness in student research projects is the inability to understand the purpose of a review of the literature in terms of its contribution to either the research process or the final report. Students often resort to the 'string of pearls' approach outlined in Unit 8, Section 4 and simply summarize texts they have found, one after another, without relating them to each other or to other parts of the report or to the research design. Especially on taught master's degree courses, but also in undergraduate degrees, the aim to enhance employability is achieved by enabling students to take a wider, more research-minded approach to practical problems in the workplace. The research component of their degrees is intended to develop this competence by linking theory to practice. The terms *concept*, *theory* and *model* were first introduced in Unit 3, Sections 4 and 5 and were used by the lecturer in Section 2 of this unit.





Here, the focus is on the process of 'theorizing' by building frameworks and models. This typically happens in the literature review and discussion sections of a research paper. This section and the previous one delve more deeply into critical evaluation of specific parts of a research paper to prepare students for Section 5 where they are presented with a complete paper to evaluate.

Self study

One way to identify critical evaluation is to look in the introduction or literature review sections of research articles for adjectives or nouns which seem negative, e.g., limited/limitations, and to identify what they describe, e.g., the research design, the sample, the reliability of the results. You can ask students to find as many evaluative words as possible and collect a list of useful expressions.

Lead in and discussion

Ask students if they can remember the lecture on mathematical modelling in Unit 3. Elicit the definitions of *model* and *theory* and where these might be found in a research paper (literature review and discussion). Unit 2, Sections 3 and 4 also discuss the link between the literature review in a research report and the real world. Link the students' responses to the section title, the aims and what the university expects, so that your students are clear that this section focuses on the theoretical foundation for research and the way this is communicated in a research paper.

Discussion

The questions are designed to review what has already been covered in earlier units and in Section 2 of this unit about frameworks, models and theories and to link this to the research process. Students should be able to suggest collocations for these words in their fields, but may not be able to explain them. You should point out that these terms are often used interchangeably, so the FAQ is only a guide, not a binding definition.



Task 1 Understanding examples of theories, models, frameworks and approaches

This task is intended to link the concepts in the FAQ to specific examples, some of which have been taken from earlier units and are therefore familiar. For several of the definitions and descriptions, more than one of the terms is acceptable or commonly used, e.g., **c** and **f** where either *model* or *theory* is possible. In the second part of the question, students are challenged to think about what is accepted knowledge in their field and therefore does not have to be critically evaluated or even referenced in a research paper, e.g., the theory of relativity.

Answers

1.1 **a** model, model, **b** framework, **c** theory or model, **d** framework, **e** models, **f** theories or models, framework, **g** approach, **h** model, theory, **i** framework, framework

1.2 open

Task 2 Preparing to align your thinking with that of lecturers in the university

This task prepares the students for Task 3, which involves listening to a focus group discussion between lecturers from a variety of disciplines. You may need to explain that a focus group is a type of research interview which involves discussion amongst a number of participants, thus providing richer data. Alternatively, you could ask Business Studies students to explain. Students are going to listen in order to be able to understand advice from lecturers rather than to acquire information or understand arguments about a concept. The advice is given indirectly, elicited by the interviewer's questions about the expected student performance in the target context. In preparation, it is important for students to imagine themselves on their degree course, doing a research project. This should help them to think about the difficulties they might face and the advice they would need. The interviewer asks questions about the research process and questions to check that she has understood responses. For students with weaker listening skills, you could provide this framework of questions and elicit what some responses might be:





- How does a student go about doing research in your discipline?
- How would a student find a topic? Is a list provided or do they find their own topic?
- Is case study methodology something that students on your degree course could do?
- Once students have chosen their topic or have an idea that they are interested in, what comes next?
- Does the main problem you see relate to a lack of connection between the research question and the literature review?

Students sometimes assume that they should work on language competence before study competence and may be resistant to doing a research project in their field. Many pre-session courses tackle this resistance by including an assessed project. The philosophy underlying this book is that language is best learnt in the context in which it will be used, i.e., the students' discipline. Tasks 2.2–2.4 are designed to make this transparent. You can broaden this discussion out to other aspects of the course you are teaching.

Answers

open

Task 3 Listening critically to identify key points about research from the focus group

Ⓜ T61, Transcript p297

The focus group discussion is scripted from an authentic series of four separate focus groups conducted with lecturers from the disciplines specified. The listening questions guide students to notice key aspects of the advice from lecturers. The questions are not answered sequentially by the speakers because they are referred to throughout the discussion.

You may decide to do this task as a jigsaw listening in which you divide the class into four groups on the basis of the degree subjects they intend to study. Each group concentrates on the points made by the lecturer closest to their discipline. In the plenary feedback, you could display the table in Appendix 9e, p257 as the groups report their findings in order to compare the variety of answers across the four disciplines. When giving their answers, encourage students to problematize the advice if anything is not clear.

The lecturers categorize types of projects and discuss how a student chooses a topic and then focuses the topic with a research question. They mention a number of different types of data-collection methods, such as observation, problem analysis or root-cause analysis. They spend quite a lot of time discussing problems their students have with research and how to rescue *weak* students so that they are able to complete their project (and hence gain a degree). You may feel that the characterization of weak students is insensitive. However, this is an opportunity for your students to hear authentic voices talking about expectations and assumptions that would normally be hidden from them. If your students can understand and follow this advice, they are less likely to be in the category of 'weak students' when they come to do their own research project.

Answers

See Appendix 9e, p257.

Task 4 Thinking critically about literature reviews

In this task, students demonstrate understanding of both the FAQ at the beginning of the section and the lecturers' advice by answering questions about the purpose for including frameworks, models and theories in a research paper. The Study smart: writing a literature review on page 255 of the Course Book summarizes the discovery learning in Tasks 3 and 4, but you could read this first with your students if you judge that they need more support to complete the tasks.

Answers

- 4.1 The literature review selects and critically evaluates relevant studies to show the development of the framework, model or theory on which the research design, data collection and discussion of findings will be based. The framework, model or theory will help to operationalize the concepts into variables that can be measured.





4.2 Critical evaluation contributes to knowledge building as explained by the lecturer in Section 2: *'... scientists publish their work within a research community and argue about the findings of other studies which may contradict their own results. It is the clash of competing claims about the meaning of research findings which refines and improves understanding and builds knowledge and theory ...'*.

4.3 They look at literature reviews and discussions in related papers, where authors have critically evaluated current understanding and research.

4.4 Abdulla and Al-Omari: Surface-Infiltration-Baseflow (SFB) conceptual rainfall runoff model and Global Climate Models (GCMs)
Lebcir et al.: framework of factors affecting performance of international students
Terbeck et al.: theory of neurobiology and models of noradrenergic mechanisms

4.5 Abdulla and Al-Omari: *What is the SFB water balance model? How is it applied and calibrated? Where is the Zarqa River basin and why is it a useful case to represent water resources in Jordan?*

critical evaluation: how well these models perform in other studies

Lebcir et al.: *Who does the label 'international student' refer to and what aspects of their performance have been researched? What factors contribute to academic success for all students in general and international students in particular? How can these factors be classified in a conceptual framework?*

critical evaluation: selection of factors from previous studies to build the questionnaire

Terbeck et al.: *What is the connection between noradrenergic mechanisms, emotional responses and implicit prejudice? What is the implicit association test (IAT)? How reliable is this test in measuring implicit racial attitudes?*

critical evaluation: justification for using the IAT for measuring implicit racism

4.6 Abdulla and Al-Omari: [The model] *performed well ...*; [The average] *... compared well to ...*

Lebcir et al.: [The results] *... are in line with [previous studies].*

Terbeck et al.: [The main finding] *... supports our hypothesis ... and supports prior theorizing ...*

Study smart: writing a literature review



This is a summary of the learning outcomes of the previous tasks. You can read through the Study smart with your students or you may like to elicit the main aspects, before you read, by asking students to explain what the purpose of a literature review is, what it might include, and what its relation is to the research question.

Task 5 Formulating research questions to guide the selection of sources for literature reviews

This task supports students to work through the research design process outlined in the focus group discussion. The research topics selected by four students are described: two are authentic student research projects, while the other two are invented examples. Students should try to write their own research questions for these topics before comparing them with the four students' initial questions in Task 5.3.

If your students are carrying out a research project, you can ask them to give each other feedback on their own topics and questions. You can use the criteria for research questions in the Study smart: writing a literature review to evaluate how well focused their questions are. One way to do this is to put students in pairs to explain their research to each other and note important aspects, then join pairs to make groups of four. Each student now explains their partner's research to the group, while the partner listens to discover anything that is being relayed incorrectly and was therefore unclear in the original explanation.



Answer

- 5.1** Christopher Steele: product design
Rowena Forbes: case study
Wu Le: literature review
Jasmin Kang: survey–interview

5.2 open

- 5.3** Christopher Steele: the answer (yes) is known beforehand.

Focused questions: *Which concepts in electricity do students find problematic? How are these concepts usually taught? How can these concepts be modelled online?*

Rowena Forbes: the focus is too narrow and does not lead to significant benefits for other museums.

Focused questions: *What are the criteria for making a museum accessible by visually impaired people? Based on these criteria, how good is Summerford museum as a tourist destination for visually impaired people?*

Wu Le: the focus is too broad to answer in the time available.

Focused questions: *What is the process of microbial enhanced oil recovery (EOR)? How is it more effective than other EOR methods? What are the limitations of microbial EOR? What further research is required?*

Jasmin Kang: the question is trivial and does not make a contribution beyond evaluating the course.

Focused questions: *What factors contribute to success in a team? What are the barriers to successful teamworking? Which of these success factors and barriers apply to teams on my course?*

Task 6 Deciding the structure of literature reviews

The lecturers in the focus group discussion emphasized the importance of linking the research question to the literature review in order to provide a context and rationale for the research, guide data collection and analysis, and frame the discussion of findings. You can point out to students that as well as the headings given here, these reports would have more detailed subheadings. The purpose of the task is for them to see a logical order for the elements in the literature review. Several orders are possible, but ask students to justify their ordering.

Answers

- Christopher Steele: d, b, f, e, a, c
Rowena Forbes: d, e, c, b, f, a
Wu Le: c, f, a, d, e, b
Jasmin Kang: e, d, c, b, f, a

Self study

Students should now be aware of the link between research questions, the literature review, the data collection and analysis, and the way these all link to arguments in the discussion or conclusion. From this unit, they should have gained a deeper understanding of the purposes of each section of a research paper and be better able to critically evaluate the papers they read. You can review each of the four Self study activities with your students before the final section on the critical evaluation of a research paper.

Vocabulary exploitation

The lecturers use a lot of informal language to hedge their comments, especially evaluative comments about students. Your students could search through the transcript of the discussion to find examples, e.g., *go about finding out* (rather than *find out*), *go away and read* (rather than *read*), *it's fair to say* [that classification is] *a bit like ...*, *people are moving towards* [the methodologies], *tend to*



Section 5

Critical reading of a research paper

What the university expects:

- critical reflection – analyze and evaluate claims and evidence; critically evaluate the quality and impact of others' work

Contexts:

- reading research papers

Aims:

- to review your understanding of how to evaluate the quality of research evidence
- to apply the framework for critical evaluation to a specific research paper

Background

This final section draws together the points about research made in the previous four sections, requiring students to critically evaluate a research paper of their own choosing that is related to their discipline. The framework for the critical evaluation of a research paper is presented again for reference in the Study smart.

Self study

Ask your students to reflect on the Self study tasks they have completed for the previous four sections in order to demonstrate their understanding of the link between research questions, the literature review, the data collection and analysis, and the way these link to arguments in the discussion or conclusion.

Lead in and discussion

Link the students' reflection on the Self study tasks to the section title, the aims and what the university expects, so that they are clear that they are going to apply the critical evaluation framework to a specific paper.

Discussion

The discussion is intended to help students to identify the overall purpose of the paper. The aspect of the study that the authors consider to be novel will be highlighted in the abstract. The arguments throughout the paper will aim to persuade the reader to accept this novel aspect as a contribution to knowledge in the field. Remind students to keep the overall aim in mind as they complete the critical evaluation of the paper. They should adopt a position of 'reasonable scepticism' towards the claims, looking for evidence to support each one. The discussion can take place in small groups, if possible of students working in similar disciplines. Readers can support each other to be reasonably sceptical.



Study smart: framework for critically evaluating research

All the questions for this framework have been developed throughout the unit, so it constitutes a brief summary of the learning outcomes. You can ask your students whether they feel ready to apply the questions to research in their disciplines.



Task 1 Critically evaluating the research paper

This task takes students through the paper step by step, asking about each section in turn.

Answers

- Students are guided to start at the end with the discussion section because this is where the authors make their strongest claims for the research they present.
- The research context should be described in the introduction and again in the conclusion. This question asks students to identify whether the paper reports a case study of a single context, hence difficult to generalize to other contexts, or a sample of a larger population, as in a survey.



- c** the research design should be clearly specified in the methods section but may also be justified in the literature review which precedes the methods. Students can refer back to sections 1 and 2 of this unit to review the difference between inductive and deductive research designs.
- d** the framework model or theory on which the research is based should be explained and justified in the literature review. The paper should show that there is a gap in the research evidence to date that this paper aims to fill. Outlining this gap should then lead to the research aims and/or questions.
- e** students should be able to see a clear link between the literature review which establishes what has been studied and not studied (the gap), what the authors decided to do (their aim or research question) and what they actually did (the data collection and analysis).
- f** the researchers should specify clearly how the theoretical concept they are interested in exploring (set out in the literature review) can be defined in a way which enables it to be measured or counted. They may use previous studies to demonstrate this operationalization.
- g** whether the independent and dependent variables can be identified depends on the type of study design (inductive or deductive) that was chosen. However, this can often be a weakness in research papers, which do not clearly show how different variables are related.
- h** the researchers should specify their sample type and size in the methods section in a way which would enable another researcher to replicate their study in another context.
- i** the authors may discuss the limitations of their sampling, measurement and interpretation in the methods section, before they present the results, or in the results section. Limitations may also be commented on in the discussion section. It is important for beginner researchers, e.g. your students, to be able to find these limitations as it enables them to critically evaluate the research in the authors' own terms, giving them confidence to add their own comments. Section 3 of this unit looks at two papers in which the authors refer explicitly to limitations.
- j** As in section 3 of this unit, students should decide how they would interpret any figures and diagrams before they read the authors' interpretation. This enables them to maintain their position of 'reasonable scepticism', waiting to be convinced by the authors that their interpretations are valid.
- k** you can refer students to question (e) above, which asks about the link between research questions, literature review and data analysis. The next move in the argument is to claim in the discussion or conclusion that the research has uncovered new insights for the field. These should be related to the gap set up in the introduction and/or literature review and to the research question. In effect the claims in the discussion should attempt to answer the research question, at least to some extent, and point the way to further research.
- l** this final task requires students to demonstrate their understanding of citation searching (refer to Unit 4 section 2) and if they are able to find papers which review their chosen paper, then they can see how other writers have critically evaluated the research. They should be able to identify which of the aspects of the framework for critical evaluation the reviewers have applied to their chosen paper, in other words, in terms of which aspects it was evaluated.



Task 2 Writing a critical review of the research paper

Students should refer to the sample answer for Section 3 of this unit, which is a critical review of the two research papers that were evaluated in that section. Their review will be a summary of selected answers to the questions above, depending on which aspects highlight limitations of the research. They should use other critical reviews to support the points they want to make. Their aim should be to show a gap in the research field by highlighting findings in their chosen study that have not been explored in a sufficient variety of contexts to be generalizable, or data collection which was not carried out rigorously enough for the results to be reliable. They may also identify claims in the discussion or conclusion which are not warranted on the basis of the research design, data collection and interpretation. Remind students to cite properly any other research articles used.

Self study

If your students have been working on a research project as they studied this book (as suggested in Unit 4), they are now in a position to evaluate the design of their own study, their critical evaluation of related research and the presentation of their findings.

