Critical thinking and problem solving: Best practice report

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Supplementary Skills for Built Environment Researchers

Guide to creative thinking, critical thinking and problem solving skills

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Introduction

This guide to creative thinking, critical thinking and problem solving skills for Built Environment researchers is prepared to provide some tips on how to enhance your skills and competence during your course of study. This is an outcome of a Centre for Education in Built Environment (CEBE) funded project, called SuSi-BER (Supplementary Skills for Built Environment Researchers) conducted within the Research Institute for the Built & Human Environment, the University of Salford.

There have been repeated calls for enhancing research and supplementary skills of the built environment researchers. Few would disagree that deepening specialised knowledge-base and wider skills of researchers in a variety of disciplines are prerequisite for developing successful leadership in higher education, the public sector and industry. We believe that, there is ample room for improvement in developing supplementary skills for quality research and researchers in the built environment. Further, as the modern society is changing in an unprecedented pace, you as an individual might realise the need to develop skills and competencies on a continual basis.

In this context, the project has been focusing on creating a foundation for creating, developing, and exploiting knowledge of supplementary skills for various activities of the built environment researchers. The project has identified and classified generic and transferable skills under the following six broad themes.

- paper / report writing skills;
- communication and presentation skills;
- personal development, professional competence, judgement and confidence;
- planning, organising, and time management;
- critical thinking and problem solving; and,
- team work and leadership.

There would be a guideline for each theme and an overall guideline for developing supplementary skills. The guides are written for everyone who is engaged in the Built Environment research, particularly postgraduate researchers reading for academic qualifications, e.g. MSc or PhD.

There is a wealth of information on each topic already available elsewhere, be it written or embedded in practice at various institutions. Due to space limitations, this guide does not provide comprehensive and exhaustive advice on each topic. Instead, this guide will provide some examples and practical tips that can help you to understand what developing each skill entails. It is hoped that this generic guide will stimulate you to think or rethink your chosen course of study as not just acquiring a qualification or passive learning experience of gaining some specialist knowledge on a research topic, but also as a process of developing you as a competent professional who can solve problems and contribute to the body of knowledge during the course of your study as well as for your future career.

This guide is thus intended to provide a foundation for which you can start with and as a common frame of reference to facilitate knowledge sharing among fellow students. For those of you who are interested in exploring further on particular topics, a reading list is provided at the end of each guide. Also remember that these supplementary skills need practice and you will learn through experience as well as reading some good materials. Like learning craft skills, we suggest that, as a starter, you emulate how other model people do and adapt their style and behaviour to suit your particular needs and style.

Developing creative thinking, critical thinking and problem solving skills

We naturally think and solve problems everyday and thus often take them for granted. However, thinking and problem solving effectively and efficiently are another matter. In this guide, we base our discussions on Simon's (1955) concept of 'bounded rationality' of human beings. That is, we think rationally but the rationality is bounded by our cognitive limitations. In other words, our purposeful behaviour is not wholly rational and thus we accept good enough solutions.

Being creative and being critical are two distinctive but ultimately complementary skills to successfully solve problems. Whilst creative thinking refers to herein generating or using unusual ideas, critical thinking denotes evaluating and judging information, insights, or ideas. The two are like both sides of a coin.

Problem solving often relates to cognitive processing directed at devising solutions to problems, which are often well-defined. In this guide, a broader view of problem solving is taken as it is more likely that we encounter problems that are neither well-defined nor wholly problematic. A problem in this guide means a troublesome situation, event, or process as well as an opportunity that can be fruitfully exploited in one's own advantage.

Creative thinking

In the main, creative thinking is a mental process that generates a wide range of ideas and opens up opportunities. Thinking creatively means we can associate one with another, be it memory, imagery, natural object, situation, event or artefact.

Creative thinking can take place in two modes: *unconscious* or *random*; *conscious* or *reflective*. In the former mode, creative ideas seem to flow when our mind is in a floating or twilight state. We sometimes have very good ideas in a relaxed mood, during meditation, or even at an unexpected moment, like Archimedes uttered 'eureka!' in a bathtub, when he discovered a method of determining the purity of gold. On the contrary, 'conscious' or 'reflective' thinking produces creative ideas with a particular purpose, whether to address a problem or to exploit an emerging opportunity. It often relies on your experience, interpretation, intuition, and insights to associate things which may seem to display no similarities or connections at all.

Creative thinking can be used both at an individual and at group levels. For example, brainstorming – a technique to create a list of options by writing out (or 'storming') ideas without sieving them in accordance with certain preferences or pre-judging values associated with the ideas – can be effectively used by an individual or in a group setting. Group brainstorming process might be facilitated by a specialist, who can ensure that people feel comfortable with presenting their own ideas in a friendly environment and there is no unnecessary criticism, interception, influence, or 'contamination' which can impede or spoil the whole process.

A plethora of tools and techniques exist for facilitating creative thinking. Some examples are listed below:

- Brainstorming;
- Brainwriting;
- Free associations;
- Clustering;
- Asking reporter's questions (who? What? When? Where? Why? And How?)
- Buzz sessions;
- Nominal group techniques;
- Morphological analysis;
- Matrix analysis;
- Attribute listing;
- Provocation; and,
- Various mapping and visualisation techniques.

Using one or a combination of the above tools and techniques might considerably improve (or in fact decrease, if used inappropriately) quality and quantity of ideas. Bear in mind that each of these tools has advantages and disadvantages, and more importantly the tools are no substitute for human creativity and luck. Explore some of the above and other techniques for creative thinking. A good starting point would be some websites (such as www.mindtools.com) where you can find brief descriptions of problem solving and decision making techniques.

Critical thinking

Critical thinking is a mental process through which we evaluate something (such as ideas, assertions, or assumptions) and make well-reasoned judgements. Thus, critical thinking is relevant not only to problem solving activities but also various other research activities such as writing and debating. The latter case is often called 'logical thinking', which helps us identify fallacies.

At times it is difficult to notice fallacies even though care is duly exercised. The following lists some types of fallacies we encounter frequently in the everyday life:

- False dilemma;
- Slippery slope;
- Straw man;
- Affirming the consequent;
- Denying the antecedent;
- Equivocation or ambiguity;
- Begging the question;
- Appeal to pity;
- Appeal to tradition;
- Appeal to force;
- Appeal to authority;
- Prejudicial language;
- Appeal to mass opinion;
- Ad hominem – abusive;
- Ad hominem – ridicule;
- Ad hominem – circumstantial; and,
- Tu quoque.

The old debate 'nature vs nurture' of creativity is a classic example of false dilemma in that the argument distracts from the truth for it is worded so that we are given two alternatives. It is probable that both can equally influence human creativity. Another example of widely encountered fallacy is 'appeal to pity/tradition/force/authority'. Regardless of the actual validity of the proposition presented, humans tend to agree with venerable or favoured persons such as an expert, a celebrity, a clergy, or mass opinion. One of the victims of such fallacies is Galileo Galilei, one of the founders of modern science. Galilei had to publicly recant his acceptance of the Copernican system under the threat of torture from the Inquisition as the authorities and general public at the time believed the Copernican system as heretical and wrong.

As argued previously, critical thinking works together with creative thinking for successful problem solving. Whereas creative thinking is useful to open up and widen a range of options from which we can choose, critical thinking allows us to clarify the problem, analyse, drill down and test the options. The former is viewed as 'diverging' process and the latter 'converging' process.

There are a wide range of tools and techniques for supporting critical thinking. Some of the examples are listed below:

- Six thinking hats;
- Cost/benefit analysis;
- Force field analysis;
- Pareto analysis;
- Paired comparison analysis;
- Grid analysis; and,
- Decision tree analysis.

Problem solving and exploiting opportunities

So far as problems have certain outcomes or their probabilities are known, problem solving can be straightforward. In this case, structured problem solving approaches are helpful. However, 'real world' problems are often far more complex than as otherwise indicated. In this situation, the task of defining problem in the first instance will be very difficult. Real world researchers then need to enter the 'system' in order to more fully understand the context and any tensions in the interpretations of the problem situation. Soft systems methodology or other variants of action research methodology are well suited to handle such problems.

Hitherto in this guide the negative aspects of 'problems'. However, for proactive problem solvers, a 'problem' or 'crisis' can be construed as an 'opportunity'. Rather than taking the problem as given (or in some case, the solution is fixed for all situations!) or waiting until the problem occurs, researchers need to proactively and appropriately use creative thinking, critical thinking and problem solving skills to explore and exploit opportunities.

Summary

This guide has discussed creative thinking, critical thinking and problem solving skills. We proposed that creative thinking and critical thinking are two different mental processes but both of them are necessary for successful problem solving. We have also highlighted that tools and techniques for supporting creative thinking, critical thinking and problem solving abound, but care should be exercised as they are no substitute for human ingenuity, insight, experience, and fortuitous interactions. Lastly, we have suggested that proactive search for opportunities to exploit is equally (if not more) important as reactive approaches towards problem solving.

References

Simon, H. A. (1955) A behavioural model of rational choice. *The Quarterly Journal of Economics*, **69**, 99-118.

Further reading list

General books and guidelines on creative thinking, critical thinking and problem solving skills abound. You may speak to other researchers and supervisors to recommend some good books appropriate to your level and needs. The following further reading list provides some materials on creative thinking, critical thinking, and problem solving, which you might find helpful:

Brahm, C. and Kleiner, B.H. (1996) Advantages and disadvantages of group decision-making approaches. *Team Performance Management: An International Journal*, **2**(1), 30-35.

Checkland, P. B. (1981) *Systems Thinking, Systems Practice,* Wiley, Chichester.

Dornan, E. A. and Dawe, C. W. (2004) *The Brief English Handbook: A Guide to Writing, Thinking, Grammar, and Research,* Pearson Longman, London.

Manktelow, J. (2004) *MindTools: Essential skills for an excellent career*, Mind Tools, West Sussex.

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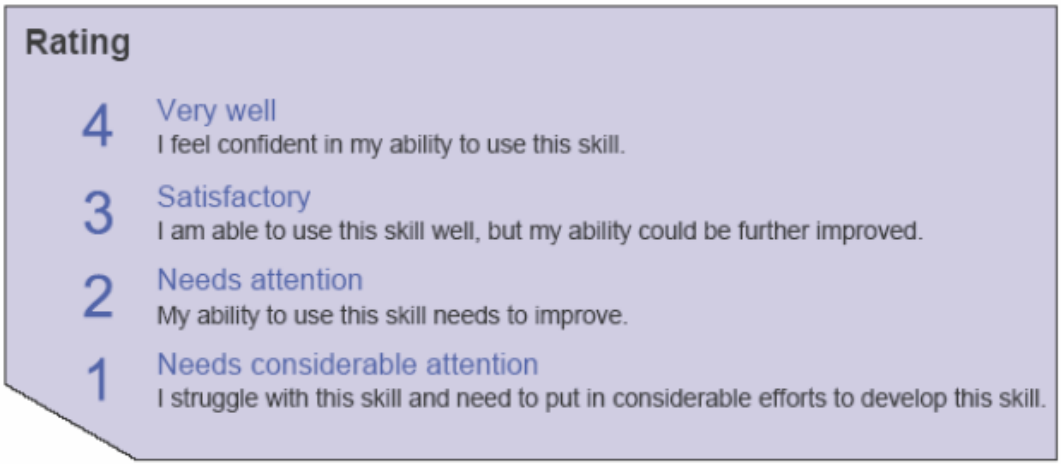
Appendix:
Self-assessment for Creative Thinking, Critical Thinking and Problem Solving Skills

Complete this Skills Audit now and compare progress each year during your PhD. Through this exercise, you would have opportunities to assess your awareness of both strengths and weaknesses. This will form the basis of your supplementary skills profile. Having completed this assessment of your supplementary skills, you may want to set targets for yourself and develop strategy to improve any aspect of the particular supplementary skills. You may want to identify sources of good practice or model which you would like to emulate or learn through experience. Some of the aspects might be discussed during workshop or training sessions in your school, research institute or university, so check with the pertinent websites or student handbook. You may also discuss with your supervisor(s), who can provide you with some help on whether there are opportunities for you to practice your skills.

Rate your ability according to the scale provided as below. As you go through each category, it is useful to think about how you can develop your skills on a short-term as well as long-term basis.



Rate your ability against each statement below:	Rating	Target	Improvement Strategy
I can clarify the nature of the problem or opportunity before taking action			
I am able to identify the sources of information and collect information in a timely manner			
I can generate alternative options for a given problem or opportunity			
I can evaluate the accuracy and relevance of information, insights, and ideas			
I can justify choosing a particular approach to problem solving and exploiting opportunities			
I am able to plan required actions to solve problems or exploit opportunities			
I can learn from experience when the solution or approach chosen was not entirely successful			
I can critically analyse assertions and reveal implicit assumptions in (both written and spoken) communications			
I can trace logical relationships and apply standards of reasoning in my paper and dialogues with peers			
I can compare and contrast between different schools of thought on a given topic			
I am able to synthesise a range of different opinions or interpretations on a given topic			

Consider your responses above and rate your overall ability for creative thinking, critical thinking and problem solving skills	Rating	Target	Improvement Strategy
Overall creative thinking, critical thinking and problem solving skills			

Any problems?

Things I need to improve

Action plan for the next review (set your own review frequency such as quarterly or yearly)