Royal Academy of Engineering

Sheffield Hallam University | Sheffield Institute of Education

THIS IS ENGINEERING

28 Creative thinking

Technique sheet

Problem-based learning resources

Introduction

Everyone is creative. We are always finding new ways to make sense of a constantly changing world. However, sometimes people think that only artists or people who create works of art like paintings or sculptures are creative. Not true! The picture shows the Atomium in Brussels – it's a sculpture and the artist was creative to design it. But so were the engineers who had to find ways to build it!

Engineers are people who need to come up with creative solutions to problems and engineering companies typically value creativity very highly. So how can we become more creative?

Why is creativity important at work?

Creativity is useful for problems that do not have an immediate solution or when the usual one has failed. It is also useful when there is an opportunity to develop a new product or way of doing things. Creativity is fun and creative workers tend to be happier, do better work and stay with their companies longer. However, this does not mean that you should be creative every second of every day! Sometimes a familiar task can be done in a tried-and-trusted way because that way works well. You don't want your dentist to try new ways of filling holes in your teeth every time you need them. A dentist who has practiced and is good at how to do them is much more comforting!

- Make sure you use your creativity when you need to – but don't feel you need to come up with a totally new solution to every single problem.

What exactly is creativity?

Creativity is a way of thinking that produces new, useful ideas or products. These two features (newness and usefulness) are critical so just thinking of new ideas (e.g. let's make a car out of raspberry jam!) that doesn't work and is not creative – it's just dreaming! And using the same old ideas because they work (this is the way we always make electric generators) is fine – but it's not creativity. Creativity typically involves two processes: divergent thinking which produces new (sometimes strange!) ideas and convergent thinking which whittles them down to the useful ones.

- Make sure you understand that true creativity involves new ideas that are useful – not just dreaming or doing the same thing over and over again because it works!

What is divergent thinking?

Divergent thinking happens when you brainstorm as many ways of solving a problem (e.g. heating

a building) or using something (e.g. what can you use a yogurt pot for – other than just holding yogurt?) as possible. It produces loads of ideas, so you follow lots of leads and diverge (move out from) the original problem or situation. When you are using divergent thinking, you do not need to check every idea as it comes to you – just note it down and think of another idea! Divergent thinking can also be done in groups, that's what a brainstorm is – everyone thinking of ideas and capturing them all on a whiteboard or large sheet of paper. Divergent thinking is fun but keep returning to the original problem or situation to keep your ideas relevant.

- Make sure you think as widely as possible when using divergent thinking tools like brainstorms. The number of relevant ideas is important – even if some of them are a bit far-fetched.

What is convergent thinking?

Convergent thinking happens when you look at the wide range of ideas produced by divergent thinking, organise them and select the ones that look useful. You may combine ideas or modify them as you converge (move towards) on the best ideas. Make sure your selected ideas are relevant and useful to your original problem. You can also agree criteria for sorting (e.g. only keep ideas that are possible with the existing equipment or rank the ideas from best to worst at using the least energy to manufacture). Convergent thinking is a sorting and sifting process which is the mirror image of divergent thinking.

- Make sure you sort your ideas carefully – don't just pick the first one you thought of! Be able to explain why you chose this idea but rejected that one. Remember that some ideas are better when they are combined into a new one.

What helps us to be more creative?

Creativity is so valuable to business that millions of pounds have been spent researching what conditions can help employees become more creative. The research shows that an openness to change, an interest in new or different ideas, an understanding that sometimes things go wrong (and a willingness to find ways put them right!), support for new ways of working by management and encouragement of team and collaborative working tend to increase workers' creativity. The least creative environments insist on everyone doing the same thing over and over again in the same way, avoid new ideas or approaches, are very quick to blame people when things go wrong, do not allow people any control over their workplace and discourage collaborative working.

- Make sure you take advantage of the opportunities for creativity and encourage others to do the same. Do not control the people who work for you so much that their creativity is restricted.

Check yourself

You should be able to answer these questions easily after reading this sheet.

1. What is the difference between divergent and convergent thinking?
2. What are the two features of a creative solution to a problem?
3. Give two examples of where creativity would be valuable and two where it might be problematic.

Taking it further

These activities will deepen your understanding of this topic.

1. These are simple exercises to practise divergent thinking.
   - **a.** Think of as many useful things you could do with a paperclip – other than joining paper together. Can you get to 5 (that's OK) or even 10 (that's very creative!). Then try the same with a piece of waste plastic piping or the packaging from a replacement fridge freezer.
   - **b.** Think of two products that are used in the same context (e.g. a cup and a saucer or a hammer and a screwdriver) and create one new product by combing them in some way. What advantage would this new product have over the two original ones?
3. Imagine what would happen if some component broke in a system. Think of a more creative way to solve the problem instead of just replacing the broken bit.
4. Try some 'what if?' exercises. Use these to practice thinking 'out of the box'.
   - **a.** What if power became free and produced no pollution? How would that change engineering projects?
   - **b.** What if water boiled at 200˚C? How might that change heating systems? Would it be better? Or worse? Why?
   - **c.** What if iron melted at 50˚C but candle wax melted at 600˚C?