Critical thinking: why is it important in the classroom?

Critical thinking is important in all levels of education, from students grappling with open-ended problems in secondary school, to mastering arguments at university level. So how can it be taught? Julian Plumley, founder of Endoxa Learning, explains

What made you start Endoxa Learning?

I am an engineer by training, so I like to draw diagrams. When I studied for my philosophy degree, I ended up drawing arguments to make them easier to understand and learn. When I researched this, I found that there was a lot of academic work supporting using argument diagrams to improve critical thinking, but no practical product that students could use. So I started the company to change this.

What is Critical Thinking?

'Critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do.'

The philosopher Robert Ennis' definition is widely used and captures the idea of critical thinking succinctly. Being "**reasonable**" means we have to give reasons for what we believe and what we decide to do; that is we have to make an argument for them. Being "**reflective**" means we think things through for ourselves, raise questions and find information, rather than acting passively. The outcome of a critical thinking process is to produce one's own argument for one's own conclusion. There is wide agreement that critical thinking is a set of skills which can be learned, practiced and improved. The consensus view in the literature on which skills are required is as follows:

Interpretation: categorising information; clarifying meaning.

Analysis: detecting and analysing arguments to identify their conclusion, premise and structure; sorting out irrelevant material

Evaluation: judging the truth of statements, the credibility of sources and the strength of arguments; anticipating objections.

Argument Creation: supporting premises; formal and informal reasoning; presenting arguments and drawing conclusions; considering alternatives.

There is also broad agreement that certain values are necessary to be a good critical thinker: **fair-mindedness**; **inquisitiveness**; **open-mindedness** and **confidence**. Students will reinforce these values when they practice critical thinking.

Is critical thinking the same as problem-solving?

In education, problem-solving and critical-thinking overlap. The extent to which they are the same depends on the subject matter and the level. In STEM subjects, lots of good problem-solving thinking is not critical thinking. But in HASS (Humanities, Arts, Social Sciences) subjects, problem solving is often an exercise in pure critical thinking.

For example, typical exam problems in A level RE are: "*To what extent was Jesus merely a political liberator?*" and "*'Good' is meaningful. Discuss.*" They require analysis and evaluation of competing arguments, some interpretation of sources, and the creation of an argument for the student's point of view. These are all critical thinking skills. Typical exam problems in A level chemistry are: "*Calculate a value for the enthalpy of lattice formation of MgO.*" and "*Explain the bonding in and the shape of a benzene molecule.*" These problems require understanding of chemistry, mathematical skill and some creativity, but not critical thinking skills.

Put simply, critical thinking is needed when the answer to the question could go 'either way' and the student has to make an argument for their point of view. In STEM subjects up to A Level, the correct answer is never in doubt, but in HASS subjects, it is. This is not to say that STEM subjects never require critical thinking skills. All subjects require critical thinking at a high enough level, where there are problems on which even the academics disagree. But in secondary school, the HASS subjects deal with open-ended problems from year 7 onwards. Therefore these are the most suitable subjects for developing critical thinking skills at school.

Why is critical thinking important?

Critical thinking is clearly important in education. In secondary schools, students are grappling with open-ended problems in HASS subjects. The requirements for critical thinking increase as the student advances through secondary school and on to higher education. At A level, the reforms introduced from 2015 increased the proportion of marks for analysis and evaluation. In higher education, the requirement to master argumentation is essential, so universities value critical thinking skills very highly.

This is also true in the workplace. Critical thinking is identified as one of the most important 21st-century work skills by the World Economic Forum (WEF). As knowledge becomes ever more easily available via the internet, recruiters will look increasingly for thinking skills. This trend is expected to accelerate as technological advances reduce the need for many traditional jobs. Since 50% of students will never enter higher education, it is essential that critical thinking skills are built up during secondary education.

However, 85% of teachers thought critical thinking skills were inadequate when students reached post-16 education (TES). Our own qualitative research in schools revealed typical worries that students have such as: losing track of the argument; not planning before starting an essay; including irrelevant information. Examiners' reports consistently point out the lack of a good argument in exam entries. Moreover, teachers express concern with regards to teaching of critical thinking skills. Students are often much better at learning facts than making a good argument, but there is no time to teach this properly in a content-heavy curriculum. The requirements to think critically have increased, but the textbooks and training have not always kept up.

Why is it difficult to learn critical thinking?

In school, students are introduced to critical thinking by reading and writing arguments in prose. The textbooks, articles and original sources they read are usually in prose, as are the essays they write. Prose is a very flexible medium, but it is not the optimal way to represent an argument.

Firstly, students cannot look at argumentative prose and immediately find the argument. Prose makes no distinction between the sentences which are part of the argument and those that do other things, such as supporting facts and context. So the argument is hidden amongst other information, much of which is distracting.

Secondly, prose is linear, but arguments are usually branched. Students cannot understand the structure of an argument by looking at the prose. Moreover, the whole structure has to be kept in mind when evaluating the argument. For example, if they find a counter-example to one step of an argument, they need to know the structure to realise whether this defeats the whole argument or just a part of it.

For these reasons, argumentative prose imposes a heavy cognitive load on the reader. Students are obliged to work hard to discover how an argument works before they can even begin to critique it. This is especially difficult for those who have reading difficulties such as dyslexia.

School students normally create their own arguments by writing essays. Even if they are well-informed they often write a lot of facts without pulling them together into an argument. The very flexibility of prose allows essays to be unrigorous, ambiguous, and irrelevant. Moreover, essays are slow for students to write and slow for teachers to check and mark, limiting the amount of arguments that can be studied in detail. For these reasons, learning critical thinking through school work is difficult and its results are patchy.

How best can critical thinking be learned?

The solution is to express arguments in a different way. An argument graph (or argument map) is a diagram that visualises an argument. This is drawn as boxes connected by arrows. The argument is "chunked" into steps which are chained together, branching as necessary. Context and facts are annotated using clickable buttons, so they do not clutter the diagram.

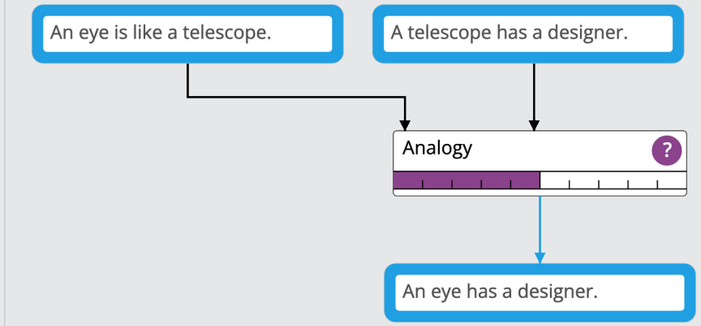
This is an intuitive way to convey how an argument works, avoiding the problems of prose. Only the statements forming the argument are displayed and the structure of the argument is immediately visible. Colours and shapes represent truth, argument strength, coherence and logic. These conventions are grasped quickly, without needing a complex training in argumentation. This method is rigorous; bad reasoning can be spotted immediately. And it is quick for a student to read or a teacher to check; far fewer words need to be read to understand the argument.

Argument graphs use the principle of dual coding to reduce cognitive load so that students can analyse and evaluate more arguments, more rigorously and in more detail. There is a large academic literature showing that this method is about twice as effective as traditional courses in improving critical thinking. (Here is a recent review.)

Where does Endoxa Learning fit in?

We are the first to apply argument graphing to a whole curriculum. Our webapp platform is like a library of textbooks for different subjects from KS3 to A level. Each subject contains 100 – 200 lessons covering the entire specification. Each lesson is based on an argument graph that students go through interactively step-by-step. All the background information and relevant facts are included, so the student learns subject knowledge as well as argument, and low-stakes testing is provided using automatically marked quizzes and reasoning tasks. At the end of the lesson, the student can edit the diagram to include their own ideas: counter-arguments, case studies, etc. They make the argument graph their own and it can be used as a visual essay plan, or revision guide.

For the teacher, the system is the same for all subjects and levels, so it only has to be learned once. A dashboard allows the teacher to set work and view progress in real time. It is suitable for use in class and at home. This is not a separate course in critical thinking, but a new way to teach which infuses a critical approach to the subject. I think this is the best way to ensure students leave school having developed these vital skills. ■



One step of an argument graph. The premises are at the top, the conclusion at the bottom, connected by an argument type box.

To find out more about Endoxa Learning, visit our website, or see us at the BETT show in London (19 - 21 Jan 2022) – **stand NA11**.

FURTHER INFORMATION

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Julian Plumley has degrees in engineering from Cambridge and in philosophy from London. He is fascinated with visualising reasoning to make complex debates more accessible to people. He is the founder of Endoxa Learning Ltd, which makes software to improve critical thinking skills.

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