

# Thinking in an Academic Environment

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**Abstract—** The original educational systems for the masses in the 19<sup>th</sup> century were designed to give a lot of pupils a little information and make them employable. Whilst the ideals and the curriculum have moved on, the educational methods have not. This paper explores the problem of the level of thinking now required in education and the hurdles that need to be overcome to provide it.

The Flynn Effect (Flynn 1987), which has seen the standard IQ scores increase by two standard deviations in 100 years, might be increased further if greater scope for thinking is provided earlier in our educational system. We propose that there are four stages of thinking; slave thinking (rote learning), constrained thinking (applying learning to new situations), operational thinking (creating and applying new rules to overcome problems) and free thinking (being able to create hypotheses and test them objectively). We then elaborate how these skills can be developed in an academic environment

**Index Terms—** Thinking, Thinking stages

## I. INTRODUCTION

Intelligence, learning and thinking are sometimes treated as being synonymous. Those who are more intelligent should be able to think better and are therefore more likely to succeed in education, particularly in higher education. However, we have all had highly successful students who seem unable to think for themselves and expect us to do that for them. After all, we are teachers, so it is our job to tell them the answers!

The discussion below should not be seen as assuming that there are four separate boxes into which people can be put. Rather they are a continuum where all four states are possible at the same time, but in different amounts. Each of us will treat a situation as we see fit and that will be different for each

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of us. For example, one could imagine a Nobel laureate asking for the time of the next bus (slave thinking). This person is not interested in why the bus is due at the time it is. However, a bus inspector could have a very different view of the same question. The inspector may hypothesise why the bus is running to this schedule and then check that assumption in some way. The inspector would be free thinking.

## II. BACKGROUND

### A. Intelligence

The nature of intelligence is still hotly debated after over a century of investigation. Legg and Hutter (Legg & Hutter 2007) cite 71 different definitions for intelligence before adding a 72<sup>nd</sup> as:-

*“Intelligence measures an agent’s ability to achieve goals in a wide range of environments.”*

The debate was started by the polymath Sir Francis Galton who, in the late 1860s (Galton 1869), devised the concept of eugenics. An aspect of this was the measurement of intelligence – the name of his study, *Hereditary Genius – The Judges of England between 1660 and 1865*, indicates the position he took. His assumption that intelligence has a genetic component is still being debated today.

Others such as Binet (Binet & Simon 1916) and Spearman (Spearman 1904) refined the work of Galton, but it was only in the 1980s that the general view of intelligence started to shift from measurement to understanding. The work of Gardner (Gardner 1999) and Sternberg (Sternberg 1985) categorised different kinds of intelligence.

However, none of these studies applied intelligence to the ability to think with the exception of Reuven Feuerstein (Feuerstein 1980; Feuerstein 1990) who believed that intelligence has a taught component and developed a teaching model, mediated learning, based on that. This might just have been an interesting exercise were it not for the work of the moral philosopher James Flynn who showed that the IQ scores have gone up significantly over the last 100 years. The Flynn Effect (Flynn 1987) showed that IQ scores had risen from 100 to 130 using standardised tests. Either our grandparents were verging on being educationally challenged, we are verging on genius or, as Flynn prefers, the educational system has laid more emphasis on thinking skills making IQ tests easier for us.

### B. Thinking

Willingham (Willingham 2009) has pointed out that students do not like school because thinking is not a natural human activity. He argues that the human brain is wired to use experience in place of thought and that this explains why those who have rote learned their tables find further arithmetic and mathematics easier. You stay ahead once you get good at something because you gain ever more experience.

Dividing thinking into different levels is not a new concept. Piaget (Piaget 1964) watched his own children and carefully monitored their journey. The four stages he saw were applied to children. This was a far more detailed view than had been taken by Bloom (Bloom et al. 1956) whose taxonomy had been seen as the route by which learning was acquired.

The Six Hats of de Bono (De Bono 1989) provided a different view of how thinking could be broken down. Here people were encouraged to take different views of a problem depending upon which hat they were given to wear. The person in the blue hat took a managerial approach, the white hatted person sought the information needed, a red hat required you to consider the emotional side of a problem whilst a black hat required discernment. If you were given a yellow hat then you were expected to take an optimistic approach and finally, a green hat was for creative thinking. This was an advance on the concept of lateral thinking (De Bono 1970) which had been so popular.

For example, to begin with, many students find programming difficult – even those who go on to get a first class honours degree. They are obviously intelligent, but struggle because the concepts seem to be outside their zone of proximal development (Vygotsky 1978). However, as they gain experience (and successes) their need to think about the code diminishes and their confidence increases. Their efforts link their existing zone of development to these new ideas and a much larger zone is created.

There is still the problem of those students who have performed well at school, who meet the university entry criteria but struggle at university. Equally anomalous are those who scrape onto a university course and then perform outstandingly well. The research literature is limited in this area, but they show a weak relationship between the course entry achievements and the degree outcomes (Bell 2003; Smithers 2004).

Below is an alternative view on why this might be. Let us start with some preliminary definitions.

### III. STAGE 1 – SLAVE THINKING

“Sit down, shut up and do what I tell you,” may not be heard so much in schools from teachers now, but the general thought pattern persists. A learner who prefers this style will

prefer it when the teachers teach. The learning is passive from the point of view of the pupil and no effort of thought is required. All the pupil has to do is follow the herd.

The learner will not stray far from their narrow zone of proximal development in the subject area being taught. There is little challenge here and no independent thought. This means that progress is slow and therefore the learner seems slow in this area. They may, however, appear much more able in other areas.

The learner will learn the logic taught (e.g. “Don’t hit other children.” or “Everything ends in a 5 or a 0 in the five times table.”), but will not seek to amend or develop rules of their own.

There is then little that can go wrong socially when learning like this because you are always behind the rest and able to follow.

The main characteristic of slave thinking is that any writing is a regurgitation of facts and lacks any application outside the one taught.

This approach is particularly applicable to primary education where facts, such as letters, numbers, reading writing, etc. have to be acquired. It is the pedagogical approach.

### IV. STAGE 2 – CONSTRAINED THINKING

This type of thinking is shown when the pupils use previous knowledge in new situations. Here rules are followed rather than sticking with the previously learned example. This means that there is potential for making mistakes, so some level of feeling socially secure is needed.

This level of thinking has a wider zone of proximal development so, again, a greater level comfort with learning is required. This means that progress is faster, but the learner may appear either lazy or slower than they actually are.

At this level the student will learn and amend the rules taught. For example, they will amend the rule not to hit other children to one which prohibits hitting anyone. They will recognise that other patterns for the times tables should also exist.

Writing produced at this level explains the concepts taught rather than just reproducing facts.

This type of thinking is typical of secondary education where facts are taught in context. The jump from primary to secondary education can cause initial difficulties if the primary education has been focussed on stage 1 thinking. There is an expectation at this stage that discussion between peers is useful, so this includes an andragogical approach to learning.

## V. STAGE 3 – OPERATIONAL THINKING

Here the thinking is creative and failure is merely a chance to improve. This gives the impression of both diligence and intelligence. Judgemental decisions about the student are ignored in preference to seeking improvement.

This type of thinking may occur with material that is outside the zone of proximal development but this is not a comfortable experience.

At this stage the learner will seek to amend the internalised logic rules acquired to new situations. For example, if there are patterns in the times tables, then there should be patterns in the equations being taught. The rule not to hit others could be adapted to, “Treat others the way you would want to be treated.”. They will seek to use analogy to find these new forms of thought.

Writing produced at this stage will seek to inform about why the topic under review works the way it does. It will show context and seek to draw more general conclusions.

This stage of thinking is required in higher education. Here students are expected to be independent learners who can explore on their own. This is the heutagogical approach to learning and that can be very challenging for those whose success has been tied to their performance at school.

## VI. STAGE 4 – FREE THINKING

Here the thinking is also creative and failure is still a chance to improve. However, imagination is used and a proactive pursuit of alternative interpretations is found.

This type of thinking may occur with material that is outside the zone of proximal development since the student naturally assumes that any difficulties can be resolved with enough effort.

Here the learner will go “off piste” with their internalised logic. They will actively seek to develop new patterns of thinking whenever a new situation develops. They will use analogy and context to create new hypotheses and then test them continuously as the information available develops.

Writing produced at this stage will seek to inform about why the topic under review works the way it does. It will show context and seek to draw more general conclusions.

This stage of thinking is required in research. Here students are expected to be independent learners who can explore on their own. This is the autagogical approach to learning (the student is a self-starter and requires little input to achieve) and that can be very challenging for those whose success has been tied to their performance at school.

## VII. OVERVIEW OF THE STAGES OF THINKING

The main aspects of these stages are summarised in the following table:-

	<b>Stage 1</b> Slave Thinking	<b>Stage 2</b> Constrained Thinking	<b>Stage 3</b> Operational Thinking	<b>Stage 4</b> Free Thinking
<b>Teaching expectation</b>	Pre-secondary	Secondary Schooling	Grad/Post-graduate	Research
<b>Teaching</b>	Pedagogy	Andragogy	Heutagogy	Autagogy
<b>Writing</b>	Regurgitate facts	Explain processes	Analyse situations Draw conclusions	Formulate hypotheses Test hypotheses
<b>Internalised logic rules</b>	Purely learned	Learned and amended	Learned, amended and adapted	Learned, amended, adapted and augmented
<b>Metacognition</b>	None	Little	Most	Full
<b>ZPD</b>	Close to ZD	In ZPD	Outside ZPD	Self-developed ZPD
<b>Social safety</b>	High	Medium	Low	None

It should be noted that increased effort and motivation are required to reach the higher stages. As Willingham (ibid.) pointed out thinking does not come naturally. This can be expressed as:-

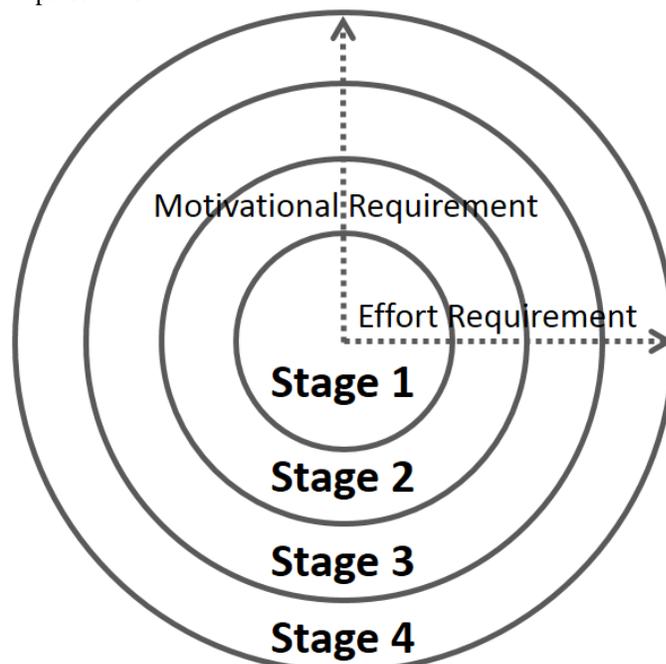


Fig. 1. The effort and motivational requirements increase as students move through the stages of thinking.

## VIII. A THOUGHT EXPERIMENT

No-one operates all at one stage, but the thinking stage preferences seem to appear early, with some pupils showing a greater willingness to think at school from day 1. Given that, how might they appear at different levels of their education if they primarily used the stages of learning?

For example, imagine four children at primary school all of whom have the same level of intelligence and who each feels most comfortable with one of the stages. The stage 1 pupil will fit right in. The pupil who prefers stage 2 thinking may get reigned in for asking too many questions. The stage 3

pupil might get their work marked as wrong because they are not using the system being taught, therefore, they have not demonstrated mastery of that topic. The one who primarily uses stage 4 might be seen as a daydreamer or argumentative, as a pupil unwilling to accept teaching.

Stage 1 thinkers might succeed at secondary school but their star will not twinkle as brightly as it did in primary school. The stage 2 thinker may or may not be asking too many questions lower down the school but come into their own the further they get and therefore out-perform the level 1 thinker. Those who prefer stage 3 thinking may still get their work marked as wrong unless their arguments are well constructed or they have understanding teachers. If stage 4 is preferred then the willingness to learn a curriculum could be curtailed unless clear reasons for needing this knowledge are given and that need is understood by the pupil.

But what happens in higher education? The stage 1 thinker is unlikely to get there, but would perform badly if they did because they are unsuited to the individualised style of thinking. The stage 2 thinker could pass but under-achieve because they have failed to demonstrate independent thinking. Finally, the stage 3 thinker comes into their own. They will perform much better than they did at school because the thinking door has been left wide open. They find themselves in the (for them) unusual situation of being praised. Those at home with stage 4 thinking will get the highest marks. This may be an unusual situation for them and they may appear under-confident at the start.

Starting research would be an impossible chore for those who are only at home with stage 1. Those who concentrate in stage 2 will be looking to synthesise existing knowledge rather than generate new areas and will therefore struggle. The stage 3 thinkers will show an aptitude for synthesising academic literature, but may struggle when required to develop new hypotheses. Those who work predominantly at stage 4 will feel right at home. They are likely see creating and testing hypotheses as a right and defending them would be part of the fun.

This is summarised in the diagram below:-

	<b>Stage 1</b> Slave Thinker	<b>Stage 2</b> Constrained Thinker	<b>Stage 3</b> Operational Thinker	<b>Stage 4</b> Free Thinker
<b>Primary Education</b>	Does very well	Told off for asking too many questions	Marked as wrong for not doing it the "right" way	Argumentative and self-assured
<b>Secondary Education</b>	Does well	Told off for asking too many questions until post-16	Marked as wrong for not doing it the "right" way unless arguments well constructed.	Argumentative and self-assured
<b>Tertiary Education</b>	Does badly because they want to be taught.	Passes but under-achieves	Does well	Does very well
<b>Research</b>	Cannot cope	May start, but ...	Struggles	Does very well

## IX. REVISITING THE LITERATURE

The introduction mentioned three methods for classifying thinking; those of Piaget, Bloom and Steiner. The diagram below shows how their levels correlate to the stages being proposed here. Piaget's Stages of Development mostly refer to pre-school and primary school learners. The major classifications for Bloom's Taxonomy fit in nicely.

The levels given by Steiner are in a similar time frame to the ones presented here, but are moved back several years.

These are shown in the table below:-

	<b>Stage 1</b> Slave Thinking	<b>Stage 2</b> Constrained Thinking	<b>Stage 3</b> Operational Thinking	<b>Stage 4</b> Free Thinking
<b>Piaget's Levels</b>	Stage 2 – Pre-operational period Stage 3 – Concrete operational period	Stage 4 – Formal operational period		Not covered by Piaget
<b>Bloom's Taxonomy</b>	Remember	Understand Apply	Analyse Evaluate	Create
<b>Steiner' Levels</b>	Stage 1* - Hands-on, creative play	Stage 2* - Artistic expression and social skills	Stage 3* - Critical skills and empathy in educational areas	Not covered by Steiner

\* Although rather earlier than the ages suggested in this paper.

## X. CONCLUSIONS

The arguments presented above have been intentionally over-simplified. No-one will be all of one stage. Everyone is likely to use all four stages simultaneously in different situations. For example, young children will exhibit stage four thinking (free thinking) when they are playing role-play games (e.g. cowboys and Indians, being an astronaut or even a teacher). Their imaginations will construct theories about these roles, construct alternative realities and apply new rules to these new situations.

The critical factor is the probability of a particular stage being used to think about each situation. The greater the probability density for the higher stages for a given problem, the higher would be the stage of the learner.

The problem then becomes whether these stages can be taught or whether they are just part of our genetic make-up. Galton (Galton 1869) believed that genetics was the answer, however, more modern work (Feuerstein 1980; Feuerstein 1990; Flynn 1987; Willingham 2009) indicates that nurture plays a far greater role. It is therefore interesting to speculate that teaching thinking patterns and encouraging more hypothesis development would result in higher level thinking. The work of Steiner (Steiner 1989) suggests that this could be started at a much younger age than previously assumed since all two year-olds go through the “Why?” stage. The work of Feuerstein (Feuerstein 1980; Feuerstein 1990) seems to support this too.

A more personalised curriculum which introduces the higher stages earlier, as put forward by Steiner, might be expected to increase the Flynn Effect further. It would also allow those who can think independently to do so and therefore increase both their enjoyment of education and their level of success. This would benefit them, those around them and society in general.

It is unrealistic to think that teachers have the time to create a personalised scheme for each child and then spend the time working with each one personally. This could be made much easier by having a bank of good materials and exercises as well as a good monitoring system. This would then allow individuals to progress at their own pace and would allow monitoring of performance so that problems can be picked up quickly. Students cannot tell the difference between something that is hard and something that is very hard – they just work through it if the environment is right.

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