

## Using Simulations to stimulate higher order thinking

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### ABSTRACT

#### Simulations: powerful learning tools

Simulations offer rich, interactive learning opportunities for students through the creation of a world in which students make decisions and respond to information as they might in a real world setting.

This year, as part of our Middle Years Enrichment Programme, Camberwell Grammar School trialled AIRLINE Online, an internet based airline management simulation. Using this software, students operating in teams, propose a business model for their airline and compete with other participating airlines for passengers and profit. Regular feedback is given in the form of comprehensive performance data for each airline, including quarterly profit, RASK, CASK and load factor, key performance indicators for any airline. This data generates discussion regarding the operation of each airline, the reasons for their various successes and disappointments, and provides the basis for ongoing decision-making. Importantly, students realise that the decisions they make affect and are affected by the decisions made by others. This interdependence is a key learning point and reinforced by each “batch” of data.

Students need to think carefully about what sort of airline they wish to operate, where and when it will fly, which aircraft will be most suitable and what in-flight services will be available, in light of the services available on competing airlines. Students are engaged by the novelty of the task, their familiarity with the context, the competitive aspects, and the complexity of the challenge.

The context of airline management provides a complex environment in which students learn to interpret and respond to performance data pertaining to many different aspects of their airline’s operation and make collaborative decisions in response, and in so doing invoke and develop a range of higher order thinking skills.

#### Introduction

Last year, at an ICT Review committee meeting at Camberwell Grammar School, the question was raised whether ICT could be used to develop students’ thinking skills, to improve their cognitive processing. Not to improve the presentation of their work; not as an organiser of ideas; not as a means of gathering information, but as a way of developing the skills they need to think through

situations so that they are better able to resolve the issues that will confront them throughout their lives.

### Thinking Skills

Over the past 30 years or so, the central concern of learning and teaching has shifted from (propositional) knowledge to thinking. The “knowledge curriculum”<sup>1</sup> is now the “thinking curriculum”. Thinking barely rated a mention in CSF II, but is a strong emphasis in VELs – and rightly so. Taught to think clearly, we are able to make considered judgements, better decisions and find viable solutions to problems we face, not only in the classroom or at school, but in every aspect of our lives.

There are many defensible ways to categorise types of thinking, which might include: investigating, analysing, evaluating, reasoning, creating and reflecting. The VELs refers to “strategies for thinking related to enquiry, processing information, reasoning, problem solving, evaluation and reflection”. Bloom’s taxonomy identifies a hierarchy of six levels of what might reasonably be referred to as types of thinking<sup>2</sup>: remembering, understanding, applying, analysing, evaluating and creating.

### What we were looking for

We wanted a way to provide an effective way of teaching thinking skills, particularly those involved in decision-making. An authentic context for this learning seemed important for a number of reasons. Firstly, since we are seeking to provide students with the thinking skills that will be useful to them throughout their lives, a “real life” context is most appropriate as it builds in the complexities, the interdependencies, which are part of our everyday thinking. An important interdependence is between people: how the decisions of others affect our decisions, which often require regular refinement in light of the changing decision-making landscape. Secondly, student engagement is often enhanced when they see that what they are learning is and will be relevant to their lives.

It was also important that students be given regular feedback on their decision-making: Did things pan out as they expected? Did they achieve the desired outcome? How might they change their decisions in light of this experience should a similar situation arise in the future? What factors did they fail to take into consideration? How has the situation changed; how should they respond?

Whilst decision-making is covered in our curriculum, the activities available failed to meet many of these criteria. We had used De Bono’s CoRT activities, but these were removed from real life experience and provided no mechanism for feedback, apart from hypothetical consequences which emerge through discussions. And, importantly, the decision-making process was static; the important aspect of operating within a dynamic, interactive environment could not be created using print media.

After discussion with David Pethick, who was working at Camberwell Grammar School, assisting students set up their own web sites, we decided to trial AIRLINE Online, to see if this software would be able to provide the sort of dynamic, interactive environment we were looking for, one which would provide a context for higher order thinking skills.

### AIRLINE Online: How it works

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<sup>1</sup> A key text in Philosophy of Education is Paul Hirst’s *Knowledge and the Curriculum*. As the title suggests, epistemology was central to the concerns of educational theorists in the 60’s and 70’s.

<sup>2</sup> Terminology is that used by Lorin Anderson in her revision of Bloom’s work.

Students participating in AIRLINE Online set up and run their own airline, from the buying of aircraft, the hiring of staff, organising maintenance, scheduling and specifying in flight services. Each airline is allocated start up funds.

1. Before entering the online environment, each airline develops a business profile using a hard copy proforma to guide them. This includes:

- name of the airline (and their logo)
- intended market (business, low cost, cargo etc.)
- base
- fleet and destinations/network planning
- budget
- a rationale for this business model.

Business profiles are posted in a public space to allow students to compare their airline with others and have the opportunity to modify their profile if, for example, they see a gap in the market or there are too many airlines competing for particular destination. From the outset decision-making is placed in a dynamic, human context.

2. Students then use AIRLINE Online to realise the conception outlined in their business profile. This process also requires more detailed practical thinking, including;

- Where will they base the airline?
- Staffing their airline
  - Training pilots
  - Managers
  - Support staff
- Selecting aircraft
  - Will these be leased, new, used and so on.
  - How will these aircraft be configured with first class, business class and economy seating?
- Customer service and amenities
  - Will they be a full service or low cost airline?
  - In-flight services
  - How will they position themselves against the competition?
- Scheduling their aircraft
  - Where are they going to fly?
  - Limitations imposed by airport and aircraft infrastructure e.g. Runway length, flight range and so on.
  - Demand and market forces
- Airfares
  - Setting airfares
- Marketing their airline

- Making sure the public is aware of their airline.

Many of the decisions made, even in these initial stages, are interdependent and require students to think carefully about the logistics and the practicality of their decisions. The degree to which they are guided in this process can be regulated, discussion used to flag important considerations. For example, a student might assume that the first thing a new airline does is buy an aircraft, not realising that to take delivery a properly trained pilot is required to fly it home. Or that an aircraft needs to be configured before it can carry passengers. The software information panel also gives advice when actions taken are not feasible, and a flow chart is also available to help guide students' thinking.

3. With their airline having taken to the skies, data is collected by running a "batch". All inputs and decisions made by the airline are then 'locked in' for a period of 3 'simulation months' (or a quarter).

A batch is run from the teacher's own control panel (called the AIRLINE Online Manager)<sup>3</sup>. The batch triggers the implementation of a series of complex calculations and algorithms which convert the inputs made by each student into a set of individual quarterly results for each airline. These algorithms take into consideration the airline's own decisions and combine them with the decisions of all other airlines in the environment, environmental variables such as historical supply and demand, interest rates, tax rates, cost of fuel and many other variables.

Once a batch has been run<sup>4</sup>, the airline is presented with results covering a range of performance indicators for their airline over the previous 3 months of operation. The simulation will then 'reopen' allowing students to review their current operation and see how they can improve the performance of their airline. Teams can also view data from the other airlines against which they are competing.

This interactive process between student and simulation is repeated over time, allowing students to refine their decisions in light of data generated by each batch, and improve the overall performance of their airline.

4. Data generated for each airline includes:
  - Number of passengers carried
  - RASK (revenue per available seat kilometre)
  - CASK (cost per available seat kilometre)
  - Route profitability
  - Comparisons with other airlines
  - Customer approval rating

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<sup>3</sup> From a teacher's perspective, the batch handles all calculations, reporting and interpretation. Knowledge of the aviation industry is not required.

<sup>4</sup> Batches are run regularly at the discretion of the administrator and take only a few minutes to generate the data.

Subsequent decisions are based largely on the information available from each batch, so students are encouraged to interpret the data carefully and discuss what modifications need to be made to improve the performance of their airline.

### How we used AIRLINE Online at Camberwell Grammar School

#### 1. Enrichment Programme

Students from Years 6 to 8 are invited to participate in our Enrichment Programme which is designed to offer high achieving students intellectual challenges and diversity in their education. The programme is grounded in the work of Renzulli and Ries, and involves enriching the academic program for able students by providing a range of academic topics to engage with, outside the mainstream curriculum.

The programme seeks to provide:

- independence in learning through an interest based inquiry approach
- development of skills in critical and creative thinking, problem solving, and decision making through active application
- the active utilisation of new knowledge through the application of appropriate methods of inquiry by individuals and/or in small group investigations of real issues

AIRLINE Online seemed to meet each of these criteria, and was included in the list of offerings for the Enrichment Programme in Term 2.

Interest in this activity was strong, and we had to set a limit of 20 students. We met once per week, just before recess, in one of the computer rooms. Students were immediately engaged, often staying behind during recess and working from home during the week. Only a very brief introduction to the software was given, students being encouraged to explore it for themselves. Initial frustrations centred on navigating the software and working out why their airline was not carrying any passengers. This is exactly the sort of problem-solving we were hoping students would encounter. Some students solved these problems within a few minutes; others needed information from a couple of batches to sort out the difficulties. David and I were available for consultation and to offer suggestions – but not answers. A batch time was set (usually 4 pm Saturday) and it was encouraging to see how many students logged on at 4:01 pm to check the progress of their airline. Competition was intense and the airline rankings were the hot topic of discussion on Monday mornings.

Each week we introduced or discussed a particular feature (for example, service levels, staffing and maintenance and, for the more advanced students, cargo) and students were encouraged to review their settings pertaining to this feature, incorporating what they had learnt. At the end of the 8 week programme, a prize of a model plane was awarded to each of the “directors” of the airline which had made the most profit.

Interestingly, at the conclusion of the activity, several students asked if they might continue the activity outside class. I was also approached by several boys who were unsuccessful in their first application due to the limit of 20 students. So we set up a new environment and made one student the administrator. He organised the whole activity, assigning start-up funds and running batches. This group met regularly at lunchtimes and required no assistance or intervention, apart from a couple of support emails to Simulate.

#### 2. Boroondara Cluster Group

We also ran this activity as a whole day programme for students from a number of schools in the area. The organisation was quite different, with batches run every half hour or so, once the airlines had been set up. The competition was keenly contested, with all students engaged and active throughout the day.

#### What we liked about the simulation

- At each stage of the simulation, students make decisions, **complex decisions** in which they need to consider a range of factors, often distant in the causal chain. This ability to bring together relevant data from disparate sources and make a clear, confident decision is a valuable skill.
- **Decisions are not made in isolation:** they need to take into account the decisions made by competing airlines.
- Students learn to work **collaboratively**, sharing ideas and identifying and playing to their individual strengths.
- The activity is “**authentic**” in the sense that it simulates as closely as possible real world situations. The algorithm used for generating airline feedback uses actual values and is updated regularly to include factors such as fuel surcharges and luggage fees.
- The simulation is **familiar** enough for students to have a feel for the sorts of factors they will need to take into account, but also includes many factors which they will not have thought about before. Most will have flown on a commercial airline, but few will have purchased an aircraft or thought about scheduling maintenance checks.
- **Feedback is virtually immediate**, and students can monitor their progress from batch to batch.
- A **wide range of data** is available for students to analyse and on which they base their ongoing decision-making.
- Parameters can be modified to create scenarios of **varying complexity**, depending on the ability of the students and the length and focus of the course.

#### What we would do differently next time

We would like to have more time to work with the software so that they have time to consolidate the skills developed. It would also be valuable to adapt some of the decision-making and data analysis skills to other situations so that students are able to see application in a variety of contexts.

#### Conclusion

AIRLINE Online provided a dynamic, interactive, responsive environment in which students were able to practise complex decision-making processes. Data from each batch provided an effective context in which students were able to develop skills of analysis and response. This application of ICT to the development of higher order thinking skills proved to be both effective and engaging for our students.