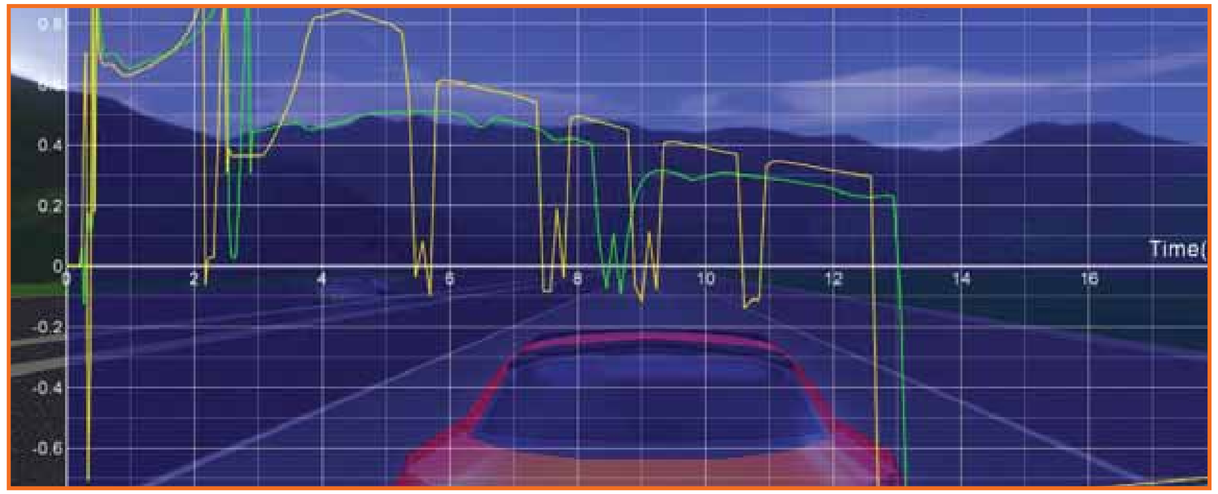
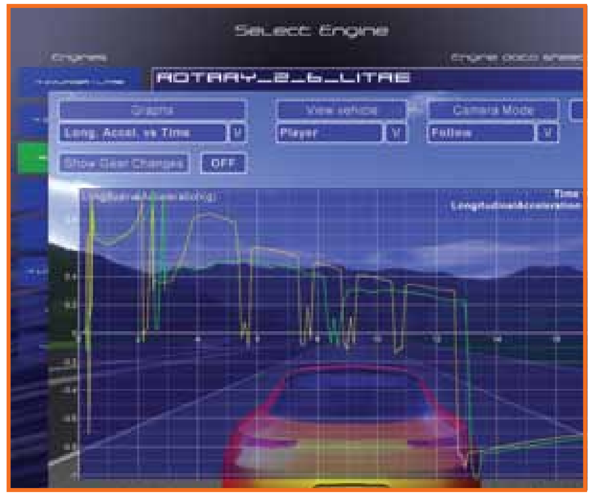
Racing Academy





Summary:

Racing Academy is a serious game prototype. Its subject matter is in the science behind automotive technology. It covers aspects of Newton's second law, interpretation of graphs, friction, gear rations and mechanical advantage/ velocity ratios and scientific inquiry.

Aims:

The aims are multifaceted: At their simplest it provides an opportunity for students to encounter scientific phenomena in the context of automobile engineering. However the main aim is to get students talking about science and engineering activity in constructive ways.

Main activities:

Students select components to build and race a drag racing car as part of a computer game. The students then compete in the game against an AI racer. By making the correct choices and learning from the telemetry students can learn to win the game.

After the game the students are given a rich and cmplex open ended simulation of racing cars and the surfaces they run on.

Racing Academy

Narrative:

The aims are multifaceted. At their simplest it provides an opportunity for students to encounter scientific phenomena in the context of automobile engineering/ More significantly it was designed to encourage students to act in particular kinds of ways:

- It provides rich opportunities for graphical interpretation and decision making about data visualisation and telemetry
- It provides opportunities for decision-making based on data in which the consequences of decisions are realized within the real world simulation
- It provides opportunities for students to discuss, with each other, problems with scientific solutions using appropriate scientific/ engineering language
- It encourages engineer-like behaviour

The resource is self-contained and can be used (and indeed has been used) in many different scenarios with different age ranges. One scenario is thus with 14-15 year old high school students.

a) Students are organised into teams of three – mixed or equal ability. They are put into teams to encourage talk about the problems, sharing of information, peer to peer teaching, sharing of both science, automobile and game-play skills. In some cases where there has been sufficient computer resource to have more than one computer per group we augmented the conversation with an instant messaging system (IMS)- that recorded the students interactions for further use

b) The challenge for students is to minimize the total time for all three members of the team in the 3rd phase of the competition. ie it is not enough to have one expert, the expertise needs to be shared

c) The students are encouraged to produce a report on the decisions they make and give reasons for their choices This provides an assessment opportunity on

The ability to chose the salient information to report

The ability to make appropriate choices in data visualisation

The ability to make appropriate conclusions from evidence presented.

There are some VERY IMPORTANT points. The teacher is strongly DISCOURAGED from

- teaching the "right answer" in advance
- teaching ANYTHING about the game in advance
- The teacher is strongly ENCOURAGED to
- Let students look up and discover the meanings of the technical language
- Answer student's questions with OTHER questions.

The game is best played when there is one computer per three students – however the game play does take place in quite short interludes and therefore other systems of managing the activity is possible. Access to things like Wikipedia – that might make explanations of words like "torque" might be useful.

After students have "won" all three races, a new environment is opened up with many more parameters and many other forms of telemetry to use. The students are also given a "race track". The student is offered many, many possibilities for experiment and "play" with physics and engineering.

End user:
Racing Academy has had successful use with different age ranges from 13 years of age to Master's degree Mechanical Engineering. It was originally designed for 14-18 year old students.

Involved actors:
Anyone competent in supervision of computers and young people and a basic knowledge of automobile technology can use the program with students. As the depth of use of the simulation progresses, greater knowledge of automotive engineering is required.

Location:
This is best used where are group of students can discuss in close proximity to a computer

Languages available:
English

Where to find the application or case:
www.lateralvisions.com/Racing_Academy/JISC_Prototype.aspx

Duration:
In the basic implementation each "race" in racing academy only takes 15 seconds. The game can be played in its entirety within 1 hour. However that does not necessarily give enough time to talk through the problems together and to devise the best reporting system. Taking about 2 hours would be more appropriate – with additional time for teams to revise and present their reports.
Other uses of the resource (eg teaching circular motion) can be structured or open ended according to needs. However the use of the open ended features after the set tasks have been completed are "open-ended".

Evaluation parameters:
The development of Racing Academy had two cycles, firstly as a Futurelab activity and secondly funded by UK JISC. In both cases extensive classroom and laboratory trials were carried out and are the subject to public reports published by Futurelab and JISC
See www2.futurelab.org.uk/resources/documents/project_reports/Racing_Academy_research_report.pdf
www.jisc.ac.uk/media/documents/programmes/elearninginnovation/racingacademyfinalreport.pdf

Connection with the curriculum:
An analysis of the correspondence between the content of the Racing Academy simulation and the UK post-16 high school physics curriculum is discussed in depth in http://web.me.com/martinowen/medruslearning/RacingAcademy_files/ra-alevel.pdf

Teachers' Competencies

1	subject matter/content knowledge	x
2	nature of science	x
3	Multidisciplinary	x
4	knowledge of contemporary science	x
5	variety of (especially student-centred) instructional strategies	x
6	lifelong learning	x
7	self-reflection	x
8	teaching/ learning processes within the domain	x
9	using laboratories, experiments, projects	x
10	common sense knowledge and learning difficulties	x
11	use of ICTs	x
12	knowledge, planning and use of curricular materials	x
13	Information and Communication Technologies with Technological Pedagogical Content Knowledge	x

PATHWAY

Mapping best practices with main principles

1. Building interest in natural science phenomena and explanations:

The activity is based around competitive game play within a quasi-authentic setting. Students can be given unlimited opportunity to test and fail in the developing of hypothesis. The real application of physics to vehicle dynamics can be explored.

2. Building up informed citizens: Students understanding the nature of Science & Science in society:

Students are asked to perform like scientists and engineers in a simulated environments. The consequences of their decisions can be tested. For instance in advanced use of the simulation provided it is possible to build the fastest car for given circumstances or build the car that runs on the least fuel.

3. Develop multiple goals:

- **understanding big ideas in science including ideas of science, and ideas about science**
- **scientific capabilities concerned with gathering and using evidence**
- **scientific attitudes**

The big idea is Dynamics. The activity is entirely evidence based and sophisticated telemetry tools are provide for gathering evidence. Decision making consequent on the evidence and the consequences of those decisions are also testable.The game is intended to be played collaboratively. Therefore scientific and technical "talk" is an important factor.

4. Understanding students' concepts and learning style about of science phenomena:

"When a 14 year old girl asks her teacher "this friction stuff - is it good to have when a car is in a drag race?" one begins to realise that setting up situations where cognitive dissonance happens in a convivial learning environment -powerful conceptual development can take place."

5. Relevance of the content to daily life of students:

Cars and motor sport are very popular. We have conducted research on gender bias in this game and we found that females were more successful than males.

6. Understanding science as a process not as stable facts. Using up-to-date information of science and education:

Progress in Racing Academy is based on making decisions of data supplied, experiments performed and the telemetry gathered. The simulation does not use cle an, simple artifica;

7. Activities for gaining knowledge, not for entertainment, nor for simple imitating of results:

Our evaluation seemed to indicate that elements of what MihalyCsikszentmihalyi described as flow – deep engagmenet with the activity. Students do learn about dynamics – they have to solve complex problems and create theories and test them – but our intention is that they are entertained by doing science in the process.

8. Doing science: experimenting, analyzing, interpreting, redefining explanations:

The whole activity is about experimenting, analyzing, interpreting, redefining explanations and in addition it is about solving problems. A significant factor is that we use real data from real situations. Because of this graphs are not the sanitized examples students usually encounter in text books – this makes analysis and interpretation realistic.

9. Assessment: formative ~ of students' learning and the summative ~ of their progress:

The assessment is intrinsic in the activity. If students master the problem, they win the race in the early stages. All actions the student takes has a visible, measurable action – with the assessment self-administered.

10. Cooperation among teachers and with experts:

We recommend that real automotive engineers, mechanics and expert drivers be available for students to enrich the experience.