Virtual Engines

CORE PURPOSE: to use simulation software to create virtual prototypes that behave realistically according to the laws of physics.

NARRATIVE OVERVIEW:

Simulations can be used for a wide range of topics and goals: science, history, business etc. They can recreate authentic conditions in which learners can experiment with decision making, problem solving or where they can try out daring and unlikely ideas in a safe environment. Engineering simulations are particularly popular as software physics engines have advanced to a level where they can simulate real-life dynamics with unprecedented accuracy. This makes them great learning tools in Maths, Science and Technology (MST).

I am a Design and Technology teacher who is just beginning to find out about the opportunities of simulations, and after a period of research and planning I finally decide to take the plunge and try this approach in my classroom. The main resource is a simulation software that can run on individual laptops, as well as on the interactive whiteboard, which in fact offers a new level of interaction thanks to its touch-based interface. Students can shift parts of a virtual prototype across the screen and see the results in real time.

The goal of the project is to build a rocket-propelled racing car. The project starts with lessons about basic content knowledge. The lessons are not didactic but structured like discussions, in which the presentation of content is always supported by active questioning and by a measured use of digital media (e.g. videos and physics games) to illustrate basic principles of rocket-science, engineering and physics.

The remainder on the project requires a degree of exploration and experimentation; during this phase I draw on the principles of enquiry-based learning to support the process. The main aim is to build a virtual prototype that behaves realistically, and does not take off when picking up speed!

During the interaction with the software, I make sure that the simulation does not end up simplifying complex dynamics; therefore I plan several de-briefing sessions in which we reflect on the process and question the underlying assumptions of the software. My ultimate aim is for students to walk away from this project with an accurate understanding of the physics or the mathematics involved.

An important part of the project is the collaborative development of an evaluation rubric to assess the prototypes. The project ends with a public display of the prototypes on the interactive whiteboard, and all prototypes are assessed collaboratively against the criteria outlined in the rubric. Eventually, a number of videos showing different phases of the project and the rocket-propelled cars in action are created and uploaded to YouTube.

TREND/S

- Growing awareness of disaffection and low attainment in relation to MST subjects
- What motivates students? Use of technology to re-engage learners with education

POSSIBLE APPROACH TO TEACHING AND ASSESSMENT

- Instructional design
- Formative assessment (e.g. dynamic questioning during classroom discussions and collaborative development of assessment rubrics)
- A degree of game-based pedagogy could also be considered (e.g. racing the prototypes, designing challenges, giving points and “achievements”)
- Enquiry-based learning

ENVIRONMENT

The classroom, mainly although homework and collaborative activities could, and should, take place outside of school time as well, as the simulation software runs on regular laptops.

PEOPLE & ROLES

The teacher initially acts as a leader and as a content expert. Students gradually take increased ownership of the process and start to develop a sense of personal involvement and attachment to the virtual prototypes. While the teacher ensures that factual knowledge is accurate and that students reflect on the underlying assumptions of the simulation, without treating it as a simple game, students take on roles as technical experts as they become more effective than the teacher in manipulating the software and exploiting its potential to the fullest. The ideal outcome of this scenario is therefore that the students and the teacher reach a balance by bringing something valuable to the process.

ACTIVITIES

- Classroom discussions around key elements of subject knowledge
- Individual study to familiarise with the resource and with the basic notions of physics.
- Implementation of a design process: from concept to prototype

RESOURCES (INCL. TECHNOLOGIES

- Simulation software with advanced physics engine and specific to the domain of engineering
- Interactive whiteboard
- Laptops
- A mobile version of the software could also be considered.
- Algodoo might be an interesting example to look at: http://www.algodoo.com/wiki/Home