

CREATING GUSTO THROUGH GAMES AND GOALS

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Introduction

Goal-based learning (GBL) has long been used for teaching (Schank and Kass, 1996) and training (Collins, 1994), and game playing is also very widely used (Fudenberg and Levine, 1998). When both are used together it can become a winning combination that focuses students' attention, dismisses precepts about a subject, lowers barriers to preferred learning-styles and open minds to new tools, ideas and concepts. The combination can be achieved using basic traditional physical props (e.g. pens and paper) or advanced internet technology. This report briefly describes an offline and online approach and then summarises some of the main benefits to be gained from combining games and goals to get students going in the right pedagogical direction.

Offline Example: Statistical Process Control 'Short Straws' Game

I have found this goal-based game approach particularly powerful when quantitative issues are being introduced to students that do not have a numerical background which sometimes means that students struggle with and shy away from tackling valuable topics head on. For instance, in the subject of Quality Management there are a broad range of topics ranging from the extremely quantitative to the extremely soft fuzzy qualitative ones. I believe that games in this subject can successfully encouraged students to tackle the more quantitative issues. For instance, Statistical Process Control (SPC) is well supported by the 'Short-Straws' game. I have used this game for undergraduate teaching and executive education training and it has been equally well received by both groups that contrast markedly in terms of experience and attitude.

The 'Short-Straws' game recreates a scenario for generating variable shop floor data, capturing and displaying it, analysing it and making suggestions for improvement actions for a production environment. This is achieved using basic stationary equipment and a few other easily available materials (i.e. drinking straws, dry spaghetti and rubber bands) to substitute material used on the production shop floor. In brief students work in teams of three, one cutting materials, one measuring and one recording lengths of cut material and one plotting the findings on a graph; all of them are then required to analyse the findings and propose some improvement recommendations. The 'Short-Straws' game can be performed in about 1 hr and should immediately follow a (1-2 hour) lecture on the theory and mathematics of SPC. It is amazing and very rewarding to see the transformation that students go through in this teaching session, it can be from one of total fear (of the formulas and concept) to one of total confidence and happiness. I believe this is because students can contextualize why the calculations are necessary, where the data comes from, and the purpose of the charts that are drawn and values that are calculated.

To make the game livelier I introduce a competitive goal-based element to it where each team must attempt to achieve the best results (i.e. process capability) possible and then present it back to the class at the end of the session. Unbeknownst to them each team has different materials to work with and slightly different equipment to use that is more or less accurate than equipment used by other teams. During the debrief all of these issues come out and combine with other factors such as human error, data rounding and process variability and brings home the reasons why SPC and production control systems are necessary if quality yield and output is to increase. After this students can find calculations that were once quite scary almost elementary by comparison.

Online Example: 'Supply Chain Management' Game

Information technology is well suited to supporting learning games and goal-based learning (Montgomery, 1994), as it can create rich scenarios and provide a medium for interactions to take place (Clegg *et al.* 2000; Clegg and Turner, 2002). The Supply Chain Game is one such goal-based game that is a web-hosted, discrete-event simulator of a network of factories and warehouses geographically distributed across as many as five different delivery regions.

I have used this Supply Chain Game for teaching large undergraduate classes on supply chain management, but it could also be appropriate for courses that include material on forecasting, inventory control, logistics, and supply chain design. I tailored the assignments to a suitable level of complexity and focused it on suitable topics related to the rest of the lectures by selecting and setting simulation parameters (e.g. production costs and holding costs) that the students will be able to modify and monitor during the game. The game's web-hosted technology facilitates a supply chain that is managed by a single firm (controlled by the student team) producing a single product for multiple unique regional markets. The student teams accessed their supply chains via the Internet.

Other than standard browsers, no software is required; and it is very easy to monitor the students' progress and settings, as well as perform other administrative functions such as starting, controlling and resetting the game. This game overcomes many of the difficulties associated with computer-based assignments, as I (or any other tutor) only need a web browser that can access the Internet. As a result, you do not need to be concerned with software installation and maintenance, or platform compatibility issues and there is no problem about getting new software installed on machines in student IT laboratories because the software resides on a central server maintained by the provider (Responsive Learning Technologies, 2008). In addition, all student assignments and handouts can be put online, so there is nothing to be physically handed out.

The Supply Chain Game, however, requires careful integration into the lecture and tutorial schedule to be successful. For example, I always give a demonstration of the online game's interface screen at least a week before the game starts, to let the students know what to expect and time to read the game scenarios and assignments. In a typical assignment, I get students to work in teams (pairs) and register their teams over the Internet. After the teams have registered, I start the game from the administrator web site. Students manage their supply chains by setting ordering parameters such as the order quantity and re-order points between each factory and warehouse. I then hold tutorials in computer labs during the running of a game (which lasts for one week). In these tutorials the students will be playing the game live whilst I am present and one-to-one clarifications can be given about the dynamics of the assignment. Students make decisions about factors such as adding capacity to existing factories or, if allowed in the assignment, to build factories and warehouses in new regions. Each team's supply chain sees the exact same environment. For example, a particular order will arrive at each teams' supply chain at exactly the same moment.

After each one-week assignment is completed, (which varies in difficulty) the cohort is debriefed in the lecture immediately following; this covers what should have been done and the most successful teams describe what they did and their rationale they used in their winning strategy. The students must then reflect on how they have done and write up the exercise reflecting on this and what they might have done better; this requires them to draw upon theories covered throughout the module. The assignments are mainly marked on the analysis in the report although a small portion of the marks also depends on the team's final ranking in the game; I find this gets a really exciting buzz going amongst the class.

Students quickly learn that most of the decisions to be made in the game are driven by forecasts, so forecasting complex demand is a key aspect of the game and is covered extensively in lectures prior to the game being run. Demand patterns can be arbitrarily complex, including cyclicity, long-run trends, infrequent large orders versus frequent small orders, end of life, and different degrees of randomness. Depending on the demand pattern, different types of extrapolation, smoothing, and

forecast updating can be appropriate. There are five regions in the Supply Chain Game and each region has its own demand. The teams need to show their judgement in order to select the most suitable forecasting methods for each region they choose to supply. I make the objectives of the game very clear: the team with the most cash at the end of the game wins. Revenues are accumulated by filling demand within a lead time requirement, investment and running costs are incurred by the teams. Learning objectives cover:

- Short-term and long term financial modelling
- Short-term and long term production and supply dynamics
- Strategic planning of resource capacity.

Typical comments from students over the last three years have been, "... it [the game] was enjoyable to use, and it was interesting to see how various strategies worked and the competitiveness was fun"; "the game was a good learning experience ... very different to other simulations done at University" and "very relevant; I particularly enjoyed the games as they are a great way of putting theory into practice". Finally, the constant availability of team standings (to see who's winning) in the Supply Chain Game builds excitement and allows students to continually assess their performance relative to peers.

Summary

The Supply Chain and 'Short-Straws' Games are good examples of goal-based games. Schank *et al* (1994) describe goal-based games as comprising a "clear, concrete goal to be achieved, a set of target skills to be learned and practiced in the service of this goal, and a task environment in which to work." Goal-based game scenarios are especially appropriate for generating an understanding of complex dynamic systems (e.g. production and supply systems), which allows students to systematically refine their understanding and intuition of system behaviour through exploration and iterative experimentation. By iteratively discussing and making decisions, observing the impact of their decisions, and refining those decisions, students develop an intuition for how supply chains and production processes behave. Students also develop the set of skills that apply lecture concepts. For example, a lecture may present the theory of 6-sigma quality control, process capability calculations, continuous replenishment system calculations and forecasting techniques and such games then allows students to develop the necessary skills to execute them. By providing a scenario that is somewhat representative of a real situation where course material can be applied, goal-based games can build student gusto for course material and learning in general.

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Example used with undergraduate and Executive Education