throughout the life of the simulated mine, from initial exploration to final site rehabilitation and evaluate their effectiveness for building systems thinking skills. Essentially students can experiment with a fully 'operational' mine [21].

ViMINE allows students to carry out a number of mine design projects where they link separate mine planning and design simulation software packages, as part of one simulation exercise – i.e. the results from one simulation tool will flow through to another. The integration of different simulation softwaretakes place in stages, as required for specific learning activities and scenarios.

The ViMINE environment allows students to design various aspects of a mining operation and assess the feasibility of different design options. The outcomes of each simulation will depend on the decisions that students have taken at previous stages in the life of mine. This ability to simulate the whole mining operation in an integrated way is a substantial qualitative improvement over current methods. A number of scenarios have been developed for students to work through in the simulated environment. These scenarios include various technical and socio-economical factors relevant to the mining industry; based on real technical data provided by the industry and including influences such as exchange and interest rate changes, commodity price fluctuations and environmental concerns. With financial support from UNSW's Faculty of Engineering and the School of Mining

Engineering the first two modules of ViMINE were developed in 2011. This included mining method selection and mine design modules using real mine data. Currently, the mining method module will be available on the worldwide web and, iPads and other smart mobile devices. ViMINE mining method selection module is a simple module used for mining method selection in the first year introductory course. Fourteen different terrains are available (Fig. 8a) to simulate the various possible surface environments which might exist in proximity to a mineral deposit. These include a range from ideal to extreme conditions. An orebody (real mine data set) is placed under the selected terrain scenario. The depth, orientation, dip and rock characteristics are selected by the instructor to set different scenario for each group. Students then decide on the mining method using their knowledge taking into consideration environment and possible community constraints. In addition, they are able to see some of the possible mining method animations to review their knowledge [21].

A detailed version of this module is being used in a third year course. In this module, students set the terrain and the orebody similar to the earlier version. Additionally, they take into account a more detailed investigation by entering appropriate assumptions using an algorithm, used for mining method selection. The method ranks possible methods based on the assumptions (Fig. 8b). Students then take into account the socio-economical considerations to make their final decision on the appropriate mining method based on their scenario.

The second module is the open pit mine module, which focuses on the planning and design for a real metalliferous mine. This module visualises the outcomes of a mine design software package including multiple pushback (cutbacks) schedule scenarios throughout the mine life, equipment selection, project evaluation and environmental constraints. Students are able to design the mine and suitably position the infrastructures based on their technical and economic decisions. In addition they can design the haul roads in and out of the pit and also select suitable equipment for thedesigned pit.

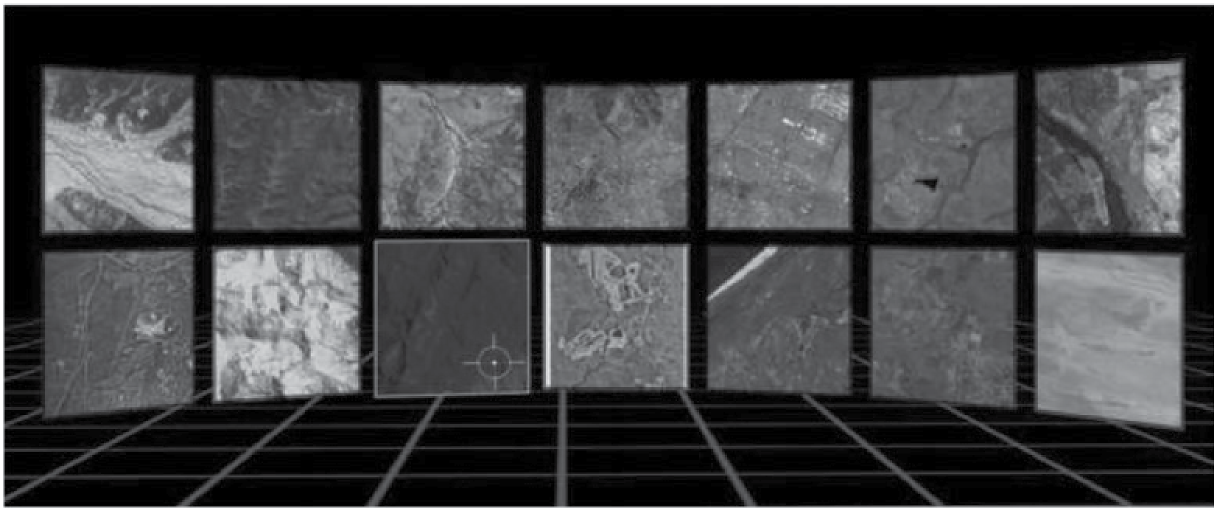

Fig. 8. (a) Selected terrain scenarios; (b) mining method ranking.