Evaluating the use of a web-based nitrogen cycle animation

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Abstract
An interactive animation of the nitrogen (N) cycle, within the context of a dairy agroecosystem, is available on the Victorian Resources Online website at: http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/soilhealth_nitrogen-cycle. It is one of a series of animations developed to capture and communicate soil knowledge and visually explain processes that occur in the soil and landscape. Animations were created from 'storyboards' (a series of hand-drawn sketches that outline all the events in the animation) developed with relevant soil scientists. This is an example of harnessing tacit knowledge of scientists, and providing context, to create an information product aimed at a broad range of users. Feedback to date has highlighted the value to users involved in agricultural extension and education. User profiling (based on IP address tracking) for a three-month period in 2013 indicated that the N cycle animation was the most extensively accessed of all animations on the website. The education and government sectors were significant user groups.

Key Words
Nitrogen cycle, animation, user analytics, knowledge management

Introduction

Since 2010, a series of interactive web-based animations have been developed on the Victorian Resources Online (VRO) website. These aim to explain dynamic, and often complex, soil and landscape processes to a broad range of users such as extension staff, educators, students and the general public. A review of available online animations in 2009 showed few products available that, in a step-by-step approach, detailed the complex nature of soil processes in agricultural systems. Many visualisation products viewed were simple flow charts, maps with animated arrows, or overly-simplified animations of complex processes. Lockwood and Heiko (1997) recognised that computing technology offered the opportunity to present educational material by combining the use of text, graphics, pictures, animations, video and sound. Literature supports the notion that media richness, focused attention, interactivity, playfulness and flow contribute towards effectiveness of learning (Guru and Nah 2001). Lewalter (2003) found that animations seem to be superior for visualisation of spatial aspects and dynamic processes. Users can also be more stimulated to use an animation because of its visual appeal as compared to static text (Russo et al. 2014).

Understanding N cycling is important for delivery of extension related to agricultural productivity and climate change. The N cycle is complex and non-experts can find it difficult to understand. The N cycle animation, available online in 2011, was the second (after carbon cycle) to be developed to support communication efforts associated with soil health and agricultural production focused projects at the time. Other available animations include soil acidification, acid sulfate soils, and the phosphorus cycle, all developed within an agroecosystem context, reflecting their development as outputs from agriculture focused projects. In this paper, we report on the development of an online N cycle animation, developed within the context of a dairy agricultural system, and provide some analysis of user trends. Web usage metrics are from 2013 when active user evaluation was undertaken for the project in which the animation was an output.

Methods

Knowledge capture

Animations were developed from 'storyboards' – a series of hand-drawn sketches that outline all the successive events in the animation. Storyboards were created with five soil scientists, each providing different perspectives of the N cycle (i.e. farming system, soil biology, soil chemistry, and greenhouse gas). Knowledge brokers facilitated the capture of knowledge into each successive storyboard and devised appropriate design features. This process is an example of harnessing the tacit knowledge of scientists: filtering, adapting and providing context to create an animation aimed at a broad range of users.

Technical Design

Adobe 'Flash' technology was used to create animations from the storyboards. 'Flash' was considered one of the premier tools for developing interactive web-based content as files are compact in size and play like movies (Holzinger and Ebner 2003). This technology allows for easy integration of sound through MP3 format, and only a small, freely available and widely used, plug-in (Adobe Flash Player) is required to view the files on a desktop/laptop computer.

Twelve separate scenes were developed that illustrate the N cycle in a dairy-based production system. Users can move through scene-by-scene or play in a continuous animation (with pre-set timing intervals). Synchronised voice-overs were included as audio files. Combining spoken text into an animation has been recommended by Van Gog and Scheiter (2010). Plate 1 shows three selected scenes from the nitrogen cycle animation, demonstrating some of the design features.

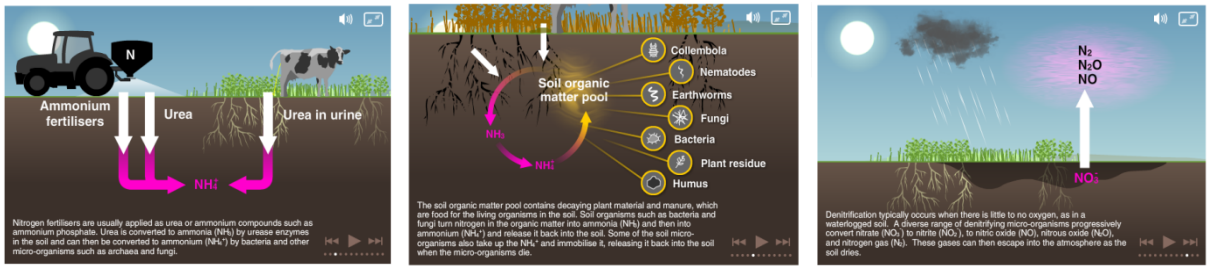

Plate 1. Three selected scenes from the N cycle animation

Google Analytics/Evaluation

Web usage was analysed using a web analytics package called *Google Analytics*. This allows quantitative data to be recorded for any given period of time (e.g. day, week, months) for any specific webpage or group of pages. The number of 'user-sessions' and 'page-views' are typical quantitative data recorded, as well as 'duration'. These basic analytics can inform about numbers of people accessing specific web content, where they are based, and also the amount of time that they are spending in the process. Further analysis of the data allows users to be profiled to a particular origin network, providing user-affiliation intelligence. Broad user categories used for this assessment included 'government', 'education' (mainly comprising universities, schools and education departments), 'ISP' (i.e. through an Internet Service Provider) and 'business/consultant'. If a user could not easily be allocated to one of these categories they were listed as 'uncategorised'. Users were also allocated according to origin, so for this paper we have also allocated them as either 'Australian' or 'International' (of which a major proportion of users were from USA).

Results and discussion

Qualitative feedback

User feedback to date has highlighted the value of animations to support agricultural extension and education. Unsolicited feedback from key users has included a university lecturer who commented that "*I have also used all the animations that are available in my teaching to illustrate the different processes that occur. The animations are particularly useful in showing dynamic processes, and feedback from the students suggests that they appreciate the short movies which are easy to understand and provide a good introduction to the topic*". Feedback from department dairy extension

staff has included: "*Fantastic animations! I am involved in giving talks on soil pH and Nitrogen...a great resource to have*" and "*Great job on the audio and animation. This makes the animations now really friendly to use with farmers*".

An online survey to assess usage of online animations on the VRO website was distributed to over 200 members of Soil Science Australia involved in education in 2014. With an 8% response rate, 65% of respondees indicated that they were aware of the soil-based animations on the VRO website. Of these, 90% 'agreed' or 'strongly agreed' that the N cycle animation is useful for teaching.

User analytics
User profiling for the period from 1 September 2013 to 30 November 2013 indicated that, of all the online soil animations, the N cycle animation was the most accessed (accounting for 44% of all user-sessions), followed by the carbon cycle (38%). This reflects the widespread interest in N and C within research, policy, extension and education communities at the time. In the period from 2011-2013, the N cycle animation was the fifth most accessed page (with 26,603 page-views) for the entire website that then comprised 7000 content pages, 2000 maps, 1000 legacy reports and online animations, videos and interactive landscape panoramas.

Figure 1 shows the relative user-sessions associated with the 'Australian' and 'International' user groups. The ISP and government category was relatively larger for Australian usage as compared to International. The relatively higher proportion of government usage reflects the animation being hosted on a Victorian government website. Education was a significant user group, particularly at the International level, with the majority being from USA. There was a smaller proportion of uncategorised at the Australian level, due to the much smaller number of, and more easily recognisable, ISPs. A significant proportion of ISP traffic could also be related to education (e.g. students accessing animations through their own ISP) but is not possible to determine.

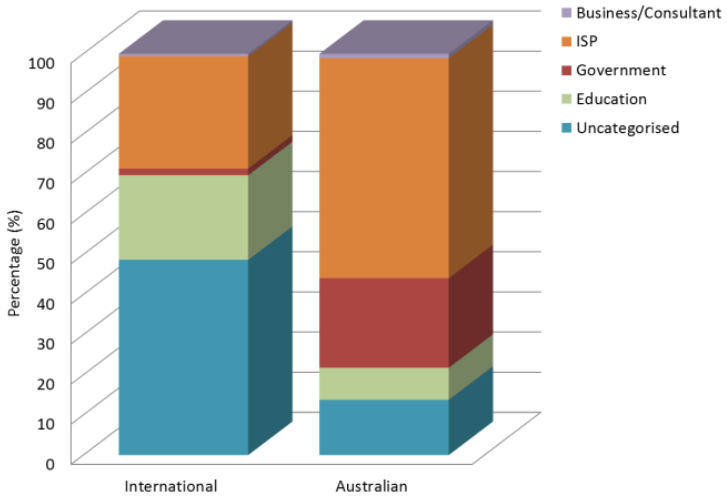

Figure 1. Broad user categories and comparison of 'International' vs 'Australian' users of the N cycle animation (1/9/13 to 30/11/13)

Some analysis was undertaken to assess trends in use associated with each frame of the N cycle animation. Results, as shown in Figure 2, indicate a gradual decline in engagement as the animation proceeds. However, retention rates at the end of the animation (a duration of four minutes twenty-five seconds) are still reasonably high (60% for the government category and just over 50% for education).

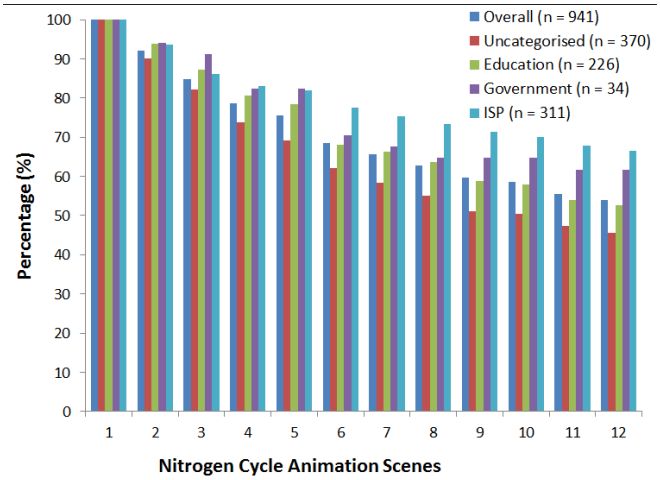

Figure 2. Percentage of users (profiled by broad user category) continuing through successive frames of the N cycle animation (1/9/13 to 30/11/13)

Future Directions

Animations can be expanded to cover additional aspects of nutrient management to improve N use efficiency and reduce environmental losses. This could be contexted for different production systems such as grain cropping, dairy and horticulture and for different landscape-climate zones. A number of the current design elements can be readily adapted as they have been, for example, in the development of the soil acidification animation where the role of N is depicted (i.e. nitrate leaching).

The use of mobile computing devices (i.e. smart phones and tablets) is rapidly increasing and some incompatibility issues have been recognised with devices that do not support 'Flash' (i.e. Apple). Future refinement of animations is planned to utilise cross-device compatible solutions based on HTML5.

Conclusion

Online animations are useful forms of knowledge management, effectively allowing for the capture and communication of specialist expertise and making it available in an engaging way to a broad target audience. Feedback to date has highlighted the value to users involved in agricultural extension and education. More quantitative user profiling for a three-month period in 2013 indicated that the N cycle animation was the most extensively accessed of all online animations and that the education and government sectors are significant user groups.

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